EDITORIAL

I WAS staggered to read, in a recent issue of "Break-in," the following words, attributed to John Clarricoats, 6GCL, general secretary of the R.S.G.B. and also secretary of Region 1, I.A.R.U. I quote:

"For the past five months, certain misguided radio amateurs, with a kink for the sensational, have been spreading or repeating rumours about reductions in this or that amateur allocation. How red will their faces be when they learn that the Geneva Conference decided to retain every current amateur band?"

If these words are to be taken at their face value, then all those who expressed concern about the future of their bands, were either spreaders of mischievous rumour, or the victims of it.

In this country, the various divisions of the W.I.A. and the Federal Executive were presumably misled. Their sponsorship of a representative at Geneva was a futile gesture and the hundreds of pounds contributed by local amateurs to secure such representation was money wasted. The wise amateurs were those who said nothing, did nothing!

What utter rubbish!

If there was no cause for apprehension, no need for representation, then what was John Clarricoats himself doing at Geneva?

It is perfectly true, as he points out elsewhere, that the amateur cause found sympathy in high places; that some delegation members, in Geneva for entirely different reasons, turned out to be amateurs. It is true that amateur representatives were able to rally this potential support so that their ultimate losses were much less than expected.

This was fortuitous indeed, but amateurs would be very foolish to assume that such circumstances must always operate to safeguard their interests. If the late John Moyle had thought that there was any cause for complacency — or red faces either — he would have been the first to say so. In actual fact, his reaction was all the other way; his report to Australian amateurs climaxed in a plea for organisation, cohesion and vigilance.

One more thing: Goodwill in high places does not come automatically. It can't be bought or organised. It has to be earned by whatever community service the amateur fraternity can offer. And it can be frittered away by internal bickering and loose talk over the air.

Complacency is a luxury which amateurs simply can't afford.

W. N. Williams

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EDITOR
NEVILLE WILLIAMS
M.I.R.E. (Aust.) (VK2XV)

TECHNICAL EDITOR
PHILIP WATSON
A.M.I.R.E. (Aust.)

TECHNICAL STAFF
JOHN BARKER
WES YASHIN
BRIAN CLEAVES
JAMIESON ROWE
MERVYN HUDDLESTON

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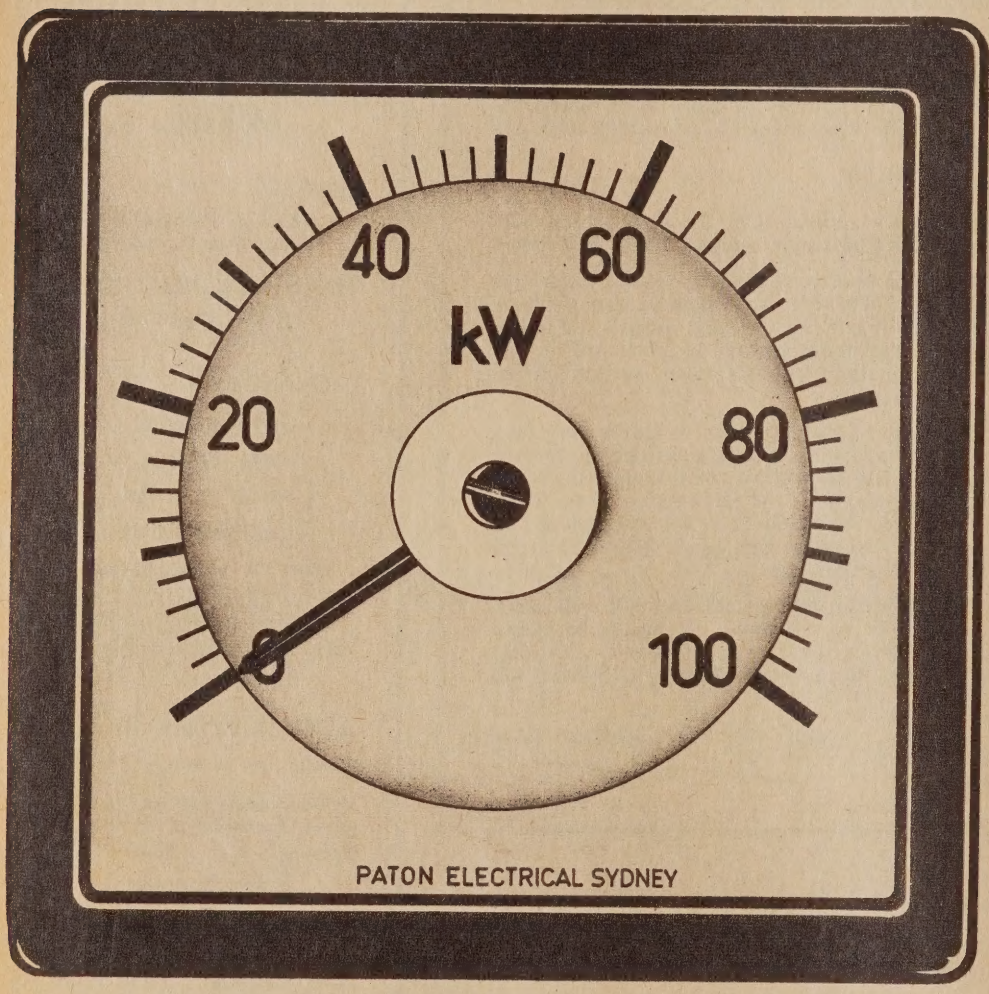

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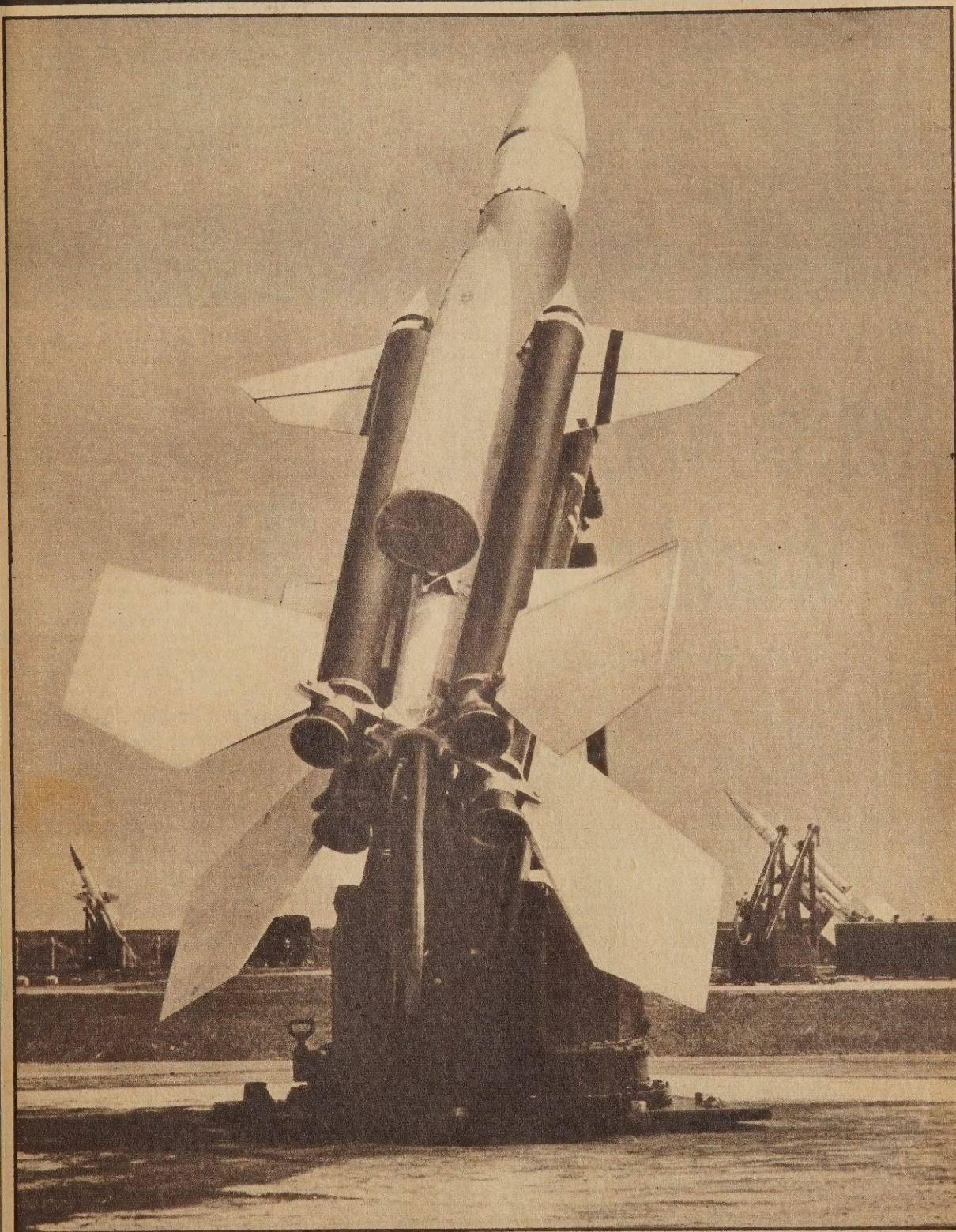
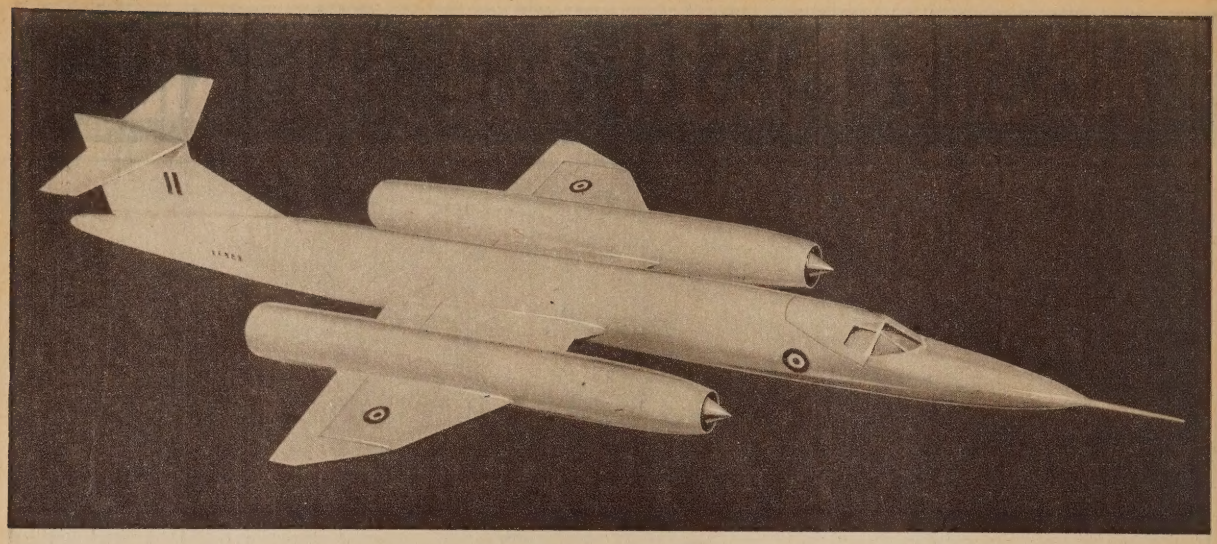
MISSILE POISED FOR THE KILL



Missiles like this Bristol "Bloodhound" have virtually rendered obsolete the manned fighter-interceptor type of aircraft. "Homing" automatically on their target, they can follow it through any evasive manoeuvre. (See story "Missile Unit For Williamtown.")



Britain's fastest aeroplane will have a most striking appearance, which suggests the flashing performance of which it will be capable.

Bristol 188 Will Be World's Fastest

By W. T. Gunston *

Working under contract to the British Ministry of Aviation, The Bristol Aircraft Company is currently developing a stainless steel, supersonic research aircraft of higher performance than any other conventional aircraft yet revealed. The writer discusses its possible significance to the British aircraft industry.

ONLY the North American X-15 rivals the speed credited to the new Bristol 188, but the X-15 has to be launched from a parent aircraft. It cannot take off by itself.

The Bristol 188 is a machine of very high technical interest and speculation about its background and its future is inevitable.

Initially one may ask what the 188 is intended to accomplish.

YEARS OF WORK

When the project started has not been divulged; Bristol Aircraft certainly started to investigate supersonic structures and methods of fabrication several years ago. The Type-number itself is no small clue, as was appointment of D. I. Vickery as design manager for the aircraft in March, 1954.

At about that time there were many projects throughout the British industry for military aircraft capable of Mach numbers of two or more and there is litttle doubt that, when the Ministry commissioned the 188, they kept at least one eye on future military requirements.

Today there is no publicly acknowledged military requirement for high-Mach aircraft and the T.188 program may have suffered both in timing and in finance as a consequence.

Actually it is to the credit of the Ministry concerned that they have continued to fund the aircraft and this may well be the first major example in recent years of a non-military aircraft being financed by British public funds.

In planning a supersonic aeroplane there are so many major variables and so many critical choices to be made that it is no easy task to finalise the design.

In the case of the 188 it seems obvious that a design Mach number of about 2.5 was chosen at the outset, but many months seem to have elapsed before the propulsive system finally settled down as a pair of de Havilland Gyron Junior PS.50 engines (DGJ.10R rating), with a maximum reheat thrust (sea-level static) of 14,000lb each.

They could have been put in the fuselage, as on the Avro Arrow, or hung under the wing, as on the defunct F-108, or even slung above and below, as on the Bloodhound; but the engines were mounted about halfway along each semi-span, with their centre-lines on the wing.

This at least facilitates the installation of alternative powerplants and allows fuselage shockwaves to create favourable intake conditions.

In any supersonic turbojet installation the intake and exhaust design is as important as the engine itself. In the 188 air is taken in via a circular pitot intake with a conical centrebody, which obviously must move axially to maintain the optimum pressure recovery.

After subsonic diffusion, the air — already very hot — enters the engine proper, traversing the variable-incidence intake guide vanes and first-stage stators, and then being compressed in the extremely efficient eight-stage compressor until it enters the combustion chamber.

AFTERBURNER

Kerosine is burnt in the high-intensity annular combustion chamber and, after passing through the two-stage turbine, the gas is reheated to 2,000 deg. K in the very advanced afterburner.

The latter, which in the 188 is obviously separated from the engine by some 15ft of pipe, ends in a multi-petal nozzle so designed that the final discharge diameter does not exceed the basic diameter of the engine envelope.

At subsonic speeds the nozzle is convergent; it opens up at supersonic speed to a parallel form at about M 1.4 (full reheat) and to a divergent form at full speed.

The superficial configuration of the 188 is amazingly conventional; in fact, it is of a form suggested by many aerodynamicists as early as 1946 and makes a good deal of sense.

The only choice which might be questioned is the use of a rear-mounted tail-

* Technical Editor "Flight"

plane; doubtless the close-knit nature of the aircraft — the span is less than that of most Austers — militated against putting a foreplane anywhere ahead of the intakes.

Wing design is fundamental. As on the defunct Avro 730 the wing appears to be chiefly occupied by nacelles and fuselage but the part which is left to provide lift has a biconvex section (t/c ratio 4 per cent) and a leading-edge sweep ranging from zero inboard of the engines to 38 deg. and finally to 64 deg.

REFINEMENTS SECRET

Nothing has been divulged concerning leading-edge flaps, or droop-snoots, or supercirculation but the wing carries trailing-edge flaps inboard of the nacelles and ailerons outboard.

The small leading-edge extensions along the fuselage and inboard side of the nacelles seem to be an attempt to improve junction flow.

Bristol state that the wing combines low supersonic wave-drag with good transonic characteristics, and thousands of hours of tunnel testing have gone into its evolution.

The three-view reveals that the aileron jacks cannot be accommodated within the wing profile.

Axial distribution of cross-section is optimised by a slight waisting of the fuselage, which otherwise has a fine profile and an oval cross-section determined by the frontal area of a pilot in an ejection seat.

In it are housed the pilot (the sole occupant), the fuel, the main and nose units of the landing gear and a vast amount of instrumentation. The pilot appears to be seated conventionally, and to enjoy fair vision through panels of heat-resistant glass mounted in the sloping windscreen forging and in the large hinged metal canopy.

To the rear fuselage is attached the squat fin (leading-edge sweep, 65 deg.) which must be stressed to meet engine-failure at full design speed. The fin carries a constant-chord rudder, and its tip is hinged and powered to drive the one-piece horizontal tail.

Very little may be revealed of the very interesting structure of the aircraft. Practically all the major portions of airframe are constructed principally in special types of stainless steel and a high proportion of the joints are welded.

It would seem logical to assume that many of the exterior panels are of some kind of sandwich construction.

LANDING GEAR

The port and starboard main legs are both cantilevered from anchorages on the flanks of the centre fuselage, like the main gear of the F-104. The forwards-retracting nose unit is steerable and employs twin wheels. A braking parachute is contained in the extreme tail.

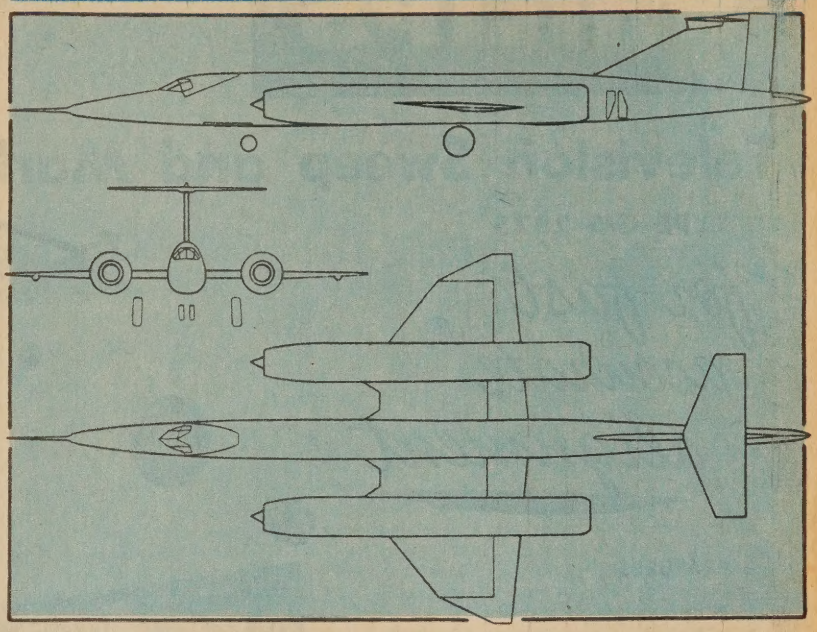
Of the 188's internal systems nothing may yet be said. It is clear, however, that in this respect this one aircraft is responsible for more hard work at the drawing board, and more arduous testing on rigs, than any other aeroplane outside the U.S.A. (and perhaps Russia).

Like its structure, the systems of the 188 press against, and often force beyond, the boundaries of previous British knowledge. It is particularly in such matters that the true worth of the aircraft is manifest, for, without it, no British supersonic transport design for a sensible Mach number could even be contemplated.

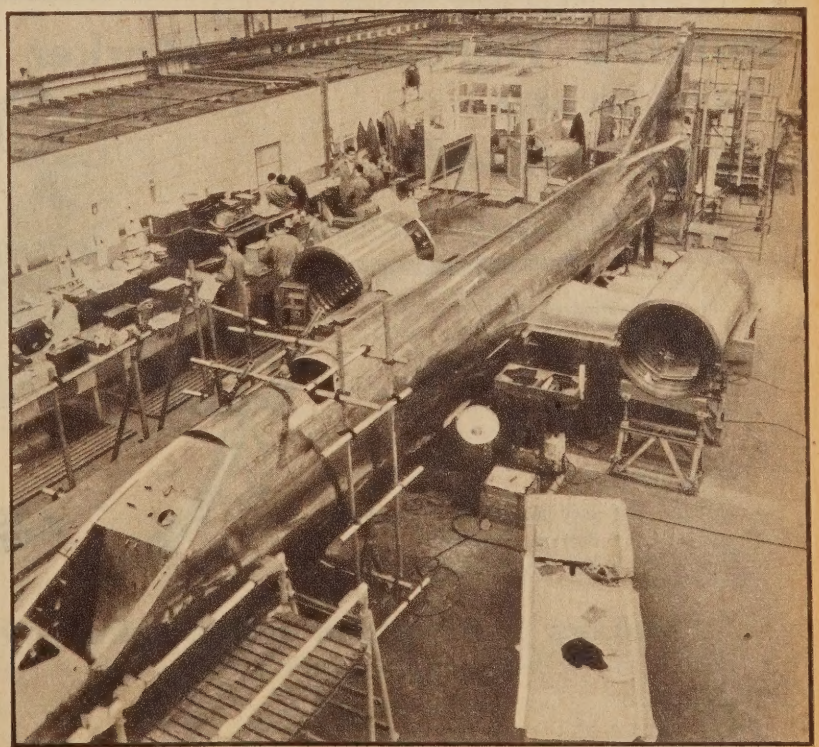
Bristol have not yet named any of their "systems" sub-contractors, but there cannot be very many famous names who do not have a finger in the 188 pie.

More than one 188 is on order, and the first is in an advanced stage at Filton, Bristol. Within the next few weeks a pair of 188 power-plants will be tested in XA552, one of the first javelin Mk Is, which Napier have re-engined for de Havilland Engines in order to allow these very advanced propulsive systems

STREAMLINED BUT TRADITIONAL



Bristol 188 (two D.H. Gyron Junior DGJ.10R): Span, 35ft 1in; overall length, excluding probe, 71ft; height 13ft 4in; gross wing area, 396 sq ft; fuselage cross section, 3ft 9in max width by 4ft 11½in max depth; design speed, "more than 1,500 m.p.h." All other data are at present restricted.



The first picture to be released of the Bristol Type 188, under construction at the Filton factory of Bristol Aircraft Ltd. It is scheduled to begin its first flying tests later this year.

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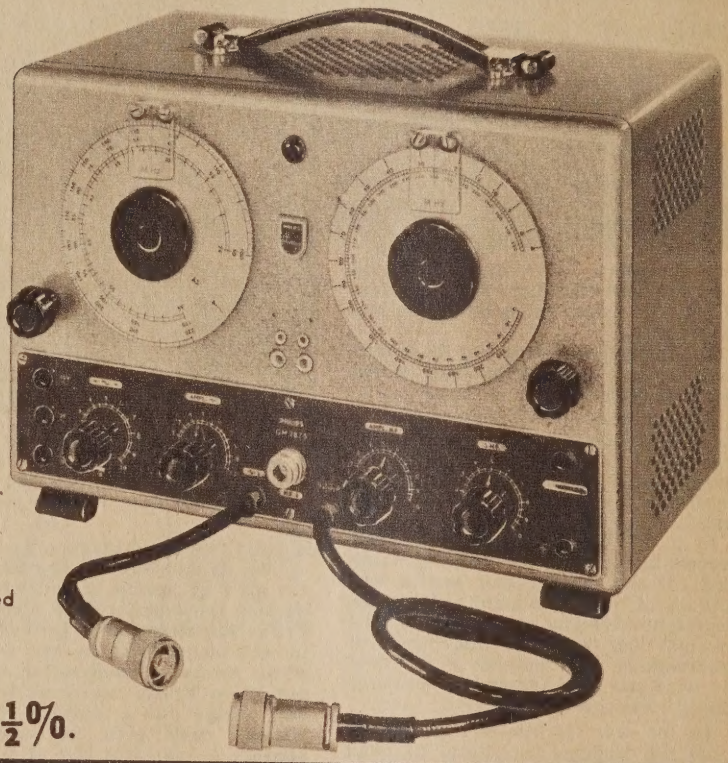

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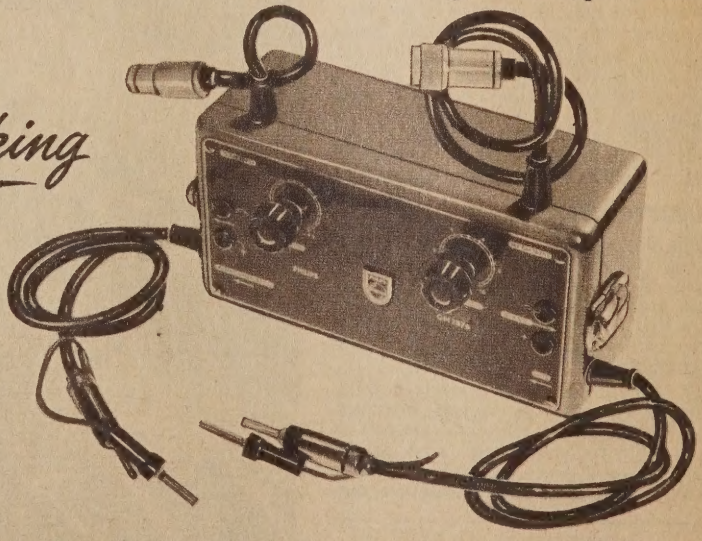

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to acquire flight time ahead of the 188 itself.

In addition, detailed investigations have been in hand for some time at the N.G.T.E. Meanwhile, Godfrey Auty, already an experienced jet pilot, is to gain supersonic experience with the Lightning, FD.2 and probably some American types, such as the F-104.

Since they are the property of the Crown, the 188s will bear Service roundels, and the first machine will carry the serial number XF923.

It is unlikely to be painted; instead its steel skin will be burnished to a high polish, producing a finish like that of an Atlas ICBM.

It would be unwise to forecast when XF923 will be rolled out or start its flight-test program. But all concerned are making great efforts to ensure that when the aircraft is finally cleared for flight, it is the most efficient research tool that the British aircraft industry can produce.

LONG JOB

Even when the flight stage has been reached it will be many months before every nook and cranny in the 188's enormous performance envelope can be explored. In view of the fact that the low-speed handling is expected to be comparable with that of the latest supersonic fighters, it is probable that the 188 will have a wider speed-range than any other aeroplane.

The initial phase of its flight-test program will be the usual familiarisation and general evaluation of its handling.

Thereafter the performance boundary will be explored and probed during at least 100 flights, before the limits of the type's capability are reached. Moreover it may well be that the airframe and systems have been designed for sustained flight at Mach numbers greater than the maximum obtainable with the present propulsion system.

One can visualise all manner of different power plants being evaluated by this aeroplane, and in particular it would appear to be an excellent test-bed for ramjet and combination turbojet/ramjet systems of the type envisaged by Bristol Siddeley Engines for future airliners.

In fact, powerplant research may well prove to be the largest single item in the long list of experiments to which this aircraft will be assigned.

Other major tasks are likely to embrace such areas as instrumentation, control and navigation systems, accessory power systems of all types, cabin-conditioning and possibly the evalution of aerodynamic surfaces with optimum lift/drag ratio or control effectiveness.

WING "GLOVES"

Whether or not "gloves" can be employed at such speeds to modify the wing profile appears uncertain in the extreme.

It is also highly unlikely that the configuration of the 188 approximates to any conceivable airliner, so that it cannot be regarded as being a scale model of something larger yet to come.

Although the investigation of flight at Mach numbers greater than two is exceedingly costly, the 188s are likely to be employed on a host of projects over a period of many years.

It could be that at least one machine might be turned over to the Aircraft Research Association, should the results from one particular set of experiments become of obvious commercial value to a particular company.

Work might also be done under contract for other European or Commonwealth countries.

The U.S.A. are continuing to fund the B-70 intercontinental bomber as a research vehicle. This aeroplane is far larger than the T.188 and will be capable of carrying much more instrumentation and of evaluating complete airliner systems while maintaining 2,000 m.p.h. for more than three hours—ensuring complete heat-soak throughout the aircraft.

Such a task is quite beyond the ability of British aircraft, but the Bristol 188 is nevertheless a vehicle of the utmost value, not only to a nation without any other aeroplane of comparable performance, but also as a morale-booster to an industry which badly needs one.

AMATEURS MAKE THE HEADLINES

On 6th March, ham radio operator Perry Klein (17), of Bethesda, at left, bounced signals from earth satellites to communicate with a fellow ham operator, Rafael Soifer, also 17, a Massachusetts Institute of Technology freshman. M.I.T. reported that the youths had accomplished what the best scientists and equipment had failed to to when they made radio contact between Bethesda and New York. After more than 100 observations during the past two years, the youths made contact by bouncing radio signals from the U.S. Explorer VII satellite and Russia's Sputnik III as they passed almost simultaneously in low orbit over Atlantic Coast.

Sen. Howard W. Cannon (left), of the Senate Space Committee, and Dr. Homer J. Stewart (centre), of the National Aeronautics and Space Administration, congratulate radio ham Perry Klein.

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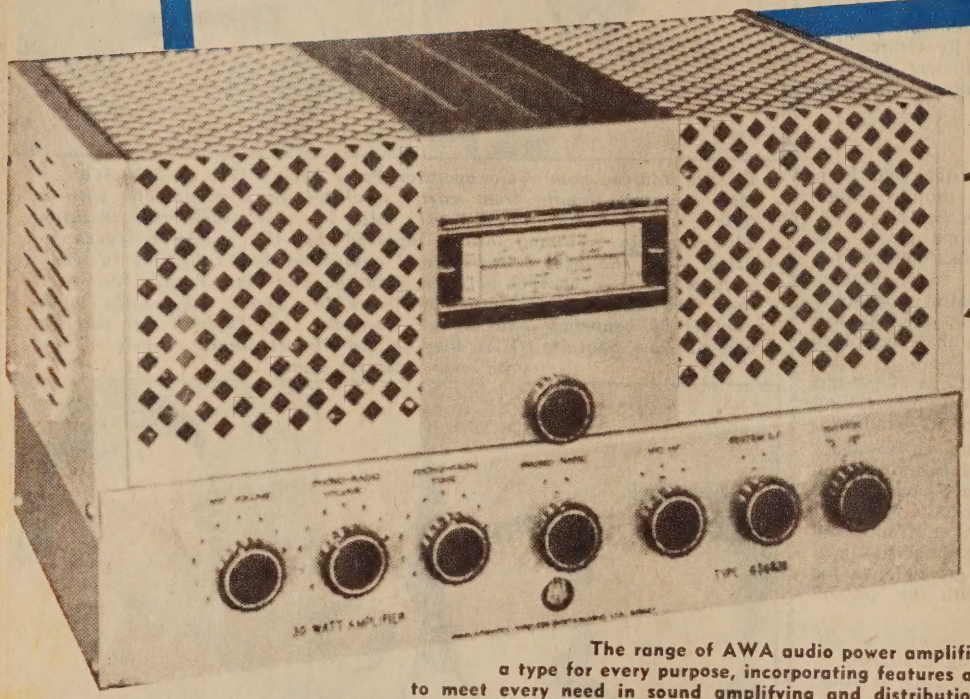

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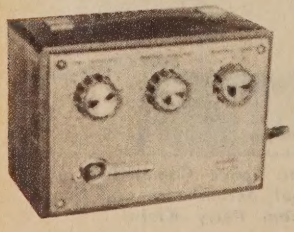

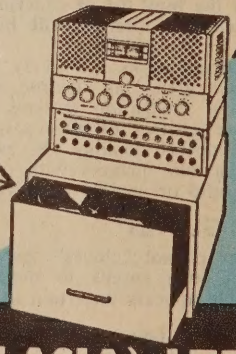

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Doppler System Is it the Answer?

A great deal has been heard lately in aeronautical circles about Doppler Navigators. This article describes how the work of an obscure Austrian scientist over a century ago has led to a brilliant new airborne navigational aid.

By H. A. Tyrer

AERIAL navigation has in the past tended to be a rather hit-or-miss affair, owing to the unpredictable forces acting upon the aircraft.

Wind speeds and directions may be constantly changing, with the result that a pilot may be flying his aircraft according to navigational data that is no longer applicable. A sudden wind change may take his aircraft miles off course before he is aware of it.

Naturally his navigational instruments will show him the true position when the next positional fix is taken, but, when he alters course to correct the error, a new set of conditions may have arisen.

LONGER ROUTE

Up till now the only disadvantage of this has been that the aircraft has flown a rather longer route than was necessary.

The rapid increase in air traffic in recent years has raised considerable problems for Airways Controllers. Because of the limitations of the navigational aids in current use aircraft flying on the air routes have to be widely spaced out to minimise the risk of collision.

Departure times from airports have to be regulated so that aircraft leaving on a particular route have 10 miles or so start before the next one takes off on the same route.

Each year more and more aircraft are coming into service on these routes, and the result is that saturation point is already being reached in some parts of the world.

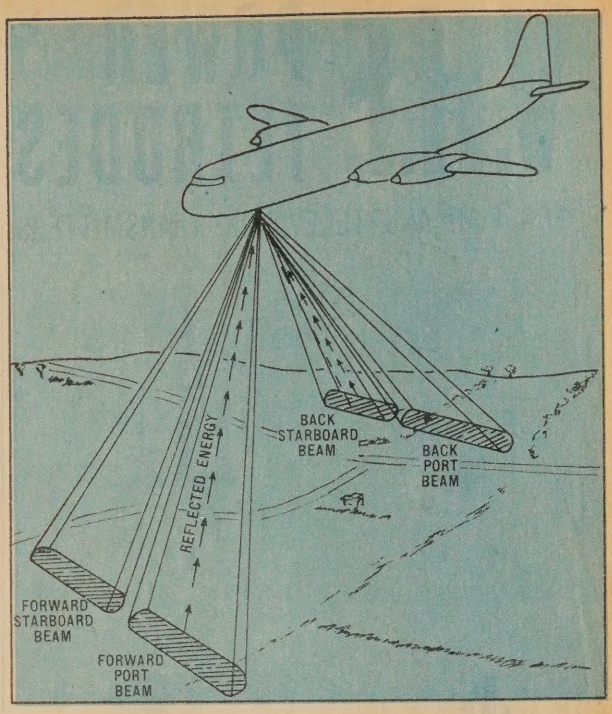
OBVIOUS VALUE

Against this background the value of Doppler Navigators comes into perspective. If controllers could know at any time the exact position of aircraft on the routes and pilots could adhere more closely to their flight plan and schedule, it would be possible to allow planes to travel less widely spaced and departure times would be speeded up.

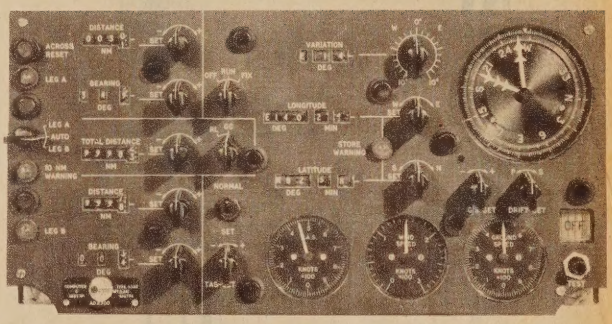
The Doppler Navigator provides the answer to this problem in a unique fashion.

The Doppler system has the special advantage that the equipment is concentrated completely within the aircraft. It does not depend on any ground installations nor does it have to be co-ordinated with the particular navigational system favoured by the country over which the aircraft happens to be flying.

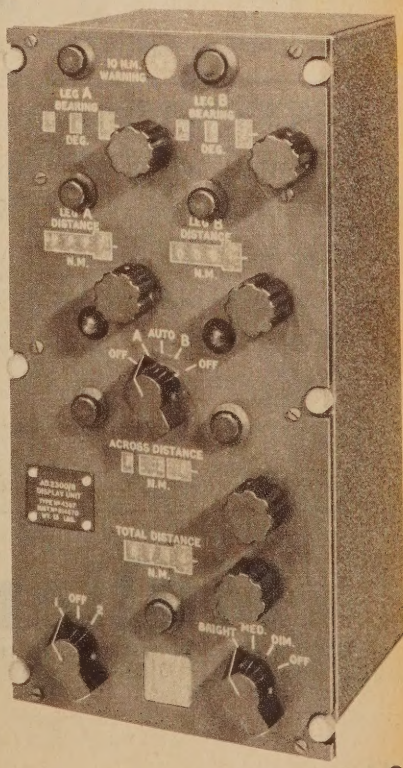
One of the problems facing international airline operators is the lack of standardisation between navigational systems and the prospect of having to carry multiple equipments which add to cost and complexity and reduce payload.



How the Doppler system of air navigation operates is illustrated in this sketch. Note that diagonally opposite beams operate simultaneously, the equipment switching rapidly and automatically from one pair to the other.



Control units such as these Marconi types present the following information: (a) Ground speed and drift angle, (b) Wind speed and direction, (c) Present position in latitude and longitude, (d) Magnetic variation, (e) Total miles to destination, (f) Miles to go on selected "leg," (g) Plan of next selected "leg," (h) Steering information to pilot's direction indicator (or to auto-pilot).



The principle on which the operation of Doppler Navigators is based was discovered by the Austrian scientist Christian Johann Doppler. Doppler noticed that sound waves emitted from a moving object appear to undergo a change in pitch when heard by a stationary observer.

NOTE VARIES

For example, the note of a train whistle appears to drop sharply when the train passes and recedes. When the train is approaching, the pitch of the whistle sounds higher than it actually is and when it is passed and is receding the pitch appears lower.

The reason for this is that the waves travelling in the same direction as the moving object become "crowded" and those travelling in the opposite direction more widely spaced. This has the same effect as raising or lowering the frequency of the sound waves and the result is a raising or lowering of the pitch.

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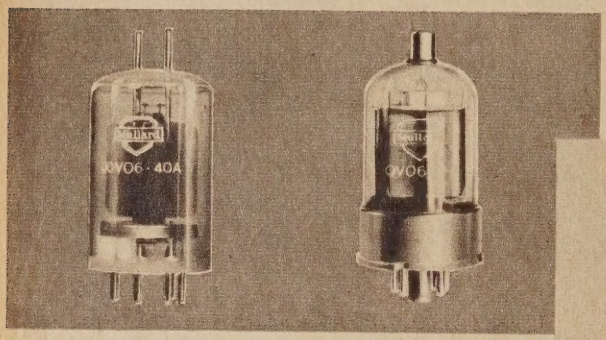

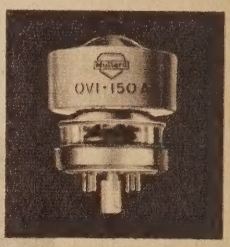

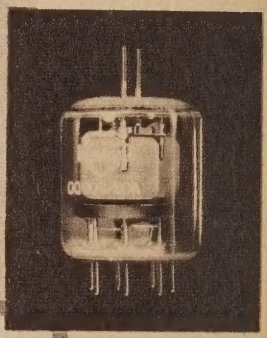

PRINCIPAL CHARACTERISTICS

MULLARD TYPE No.	AMERICAN TYPE No.	CV TYPE No.	DESCRIPTION	BASE	HEATER (V)	HEATER (A)	Va max. (V)	pa max. (W)	TYPICAL LOAD POWERS AND FREQUENCIES (W)	TYPICAL LOAD POWERS AND FREQUENCIES (Mc/s)
QV06-20	6146	CV3523	V.H.F. Power Tetrode	Octal	6·3	1·25	600	20	52 25	60 175
QV1-150A	4X-150A	CV2519	V.H.F. Power Tetrode	B8F	6·0	2·6	1250	150	195 140	165 500
QQV03-20A	6252	CV2799	V.H.F. Power Double Tetrode	B7A	6·3 12·6	1·3 0·65	600	2 x 10	48 20	200 600
QQV06-40A	5894A	CV2797	V.H.F. Power Double Tetrode	B7A	6·3 12·6	1·8 0·9	600	2 x 20	90 60	200 475
QY3-125	4-125A	CV2130	V.H.F. Power Tetrode	B5F	5·0	6·5	3000	125	375	120
QY4-250	4-250A	CV2131	V.H.F. Power Tetrode	B5F	5·0	14·0	4000	250	1000	75
QY4-500A	4X-500A	—	V.H.F. Power Tetrode	—	5·0	13·5	4000	500	900	110
QY5-3000A	6076	—	V.H.F. Power Tetrode	Special 4-pin	6·3	32·5	5000	3000	4100 2600	75 220

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It was soon found that light waves are affected in the same way and this discovery proved to be of value to astronomers, who were able to calculate the speed at which stars were receding from or approaching our planet. Radio waves have many properties in common with light waves and, shortly after the discovery of radio waves, it was found that they also are subject to the Doppler effect.

Although all these discoveries were made a long time ago, it was not till quite recently that any practical use was found for the Doppler shift of radio waves. During World War II, scientists discovered a way of using it for more accurate gun-laying on moving targets and further research proved it had a valuable application in radar to differentiate between stationary and moving objects.

FIRST EXPERIMENTS

The application of the Doppler effect to aerial navigation began shortly after the war's end, when Ministry of Supply scientists in Britain devised a simple experimental equipment. It was from this that the first operational equipment was developed and soon many aircraft of the Royal Air Force were equipped with the new device.

The practical value of the system was soon abundantly proved, with the result that electronic concerns began to produce systems for civilian use.

The systems are all basically the same, but as they differ in detail, only one will be described here.

The transmitter in the aircraft feeds radio signals to the aerial system which shoots them groundwards in two beams, one directed forward, the other backward. A small proportion of the signal is reflected from the ground, finds its way back to the aerial in the aircraft and is fed to the receiver and thence to the computer.

Because of the relative motion of the aerial to the ground the frequency of the returning waves differs from those transmitted, those from the forward beam being at a higher frequency, those from the backward beam at a lower frequency.

DOPPLER FREQUENCY

The two frequencies are compared electronically in the receiver and a third frequency, called the Doppler frequency, is obtained. The speed of the aircraft over the ground can be directly calculated from this frequency.

The drift angle is found by switching the beams rapidly from side to side so that when one beam is to port, the other is to starboard. The sideways motion of the aircraft in relation to the ground is found by comparing the frequency when the forward beam is displaced to starboard and the backward beam is displaced to port with the frequency when the beam positions are reversed.

A "computer" section of the equipment processes the data continuously and displays vital flight information to the pilot or for use by the automatic pilot system.

At take-off the known latitude and longitude of the airport is supplied to the computer. Thereafter, it progressively modifies this figure in accordance with instantaneous ground speed, direction, drift, etc., to indicate the plane's position at all times.

VITAL INFORMATION

When fully correlated with flight data, the equipment displays the following information directly on the instrument panel.

Aircraft position in latitude and longitude displayed in degrees and minutes.

Distance to go along a leg of a pre-determined flight plan.

Distance to go to destination.

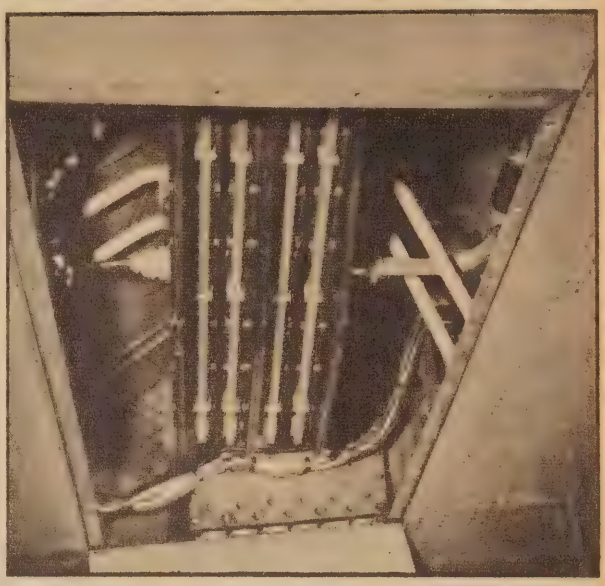
Wind speed and direction.

Ground speed and drift angle.

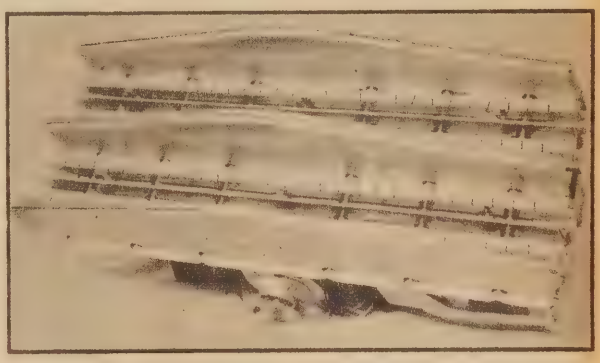
True airspeed.

Accuracy of navigation can thus be guaranteed, and aircraft can report their exact position at any time they are required to do so. An obvious extension of Doppler navigation is fully automatic flight programming. It may not be too long before aircraft will be navigated entirely by automatic means, linked with a master control operated by Air Traffic Control Centres.

DOPPLER AERIAL UNIT



The aerial unit of a Marconi Doppler navigator mounted in the starboard wing of a BOAC Britannia.



A close-up of an aerial unit, actually a developmental model.

Taken during proving tests, this picture shows some of the equipment mounted in a Viking aircraft.

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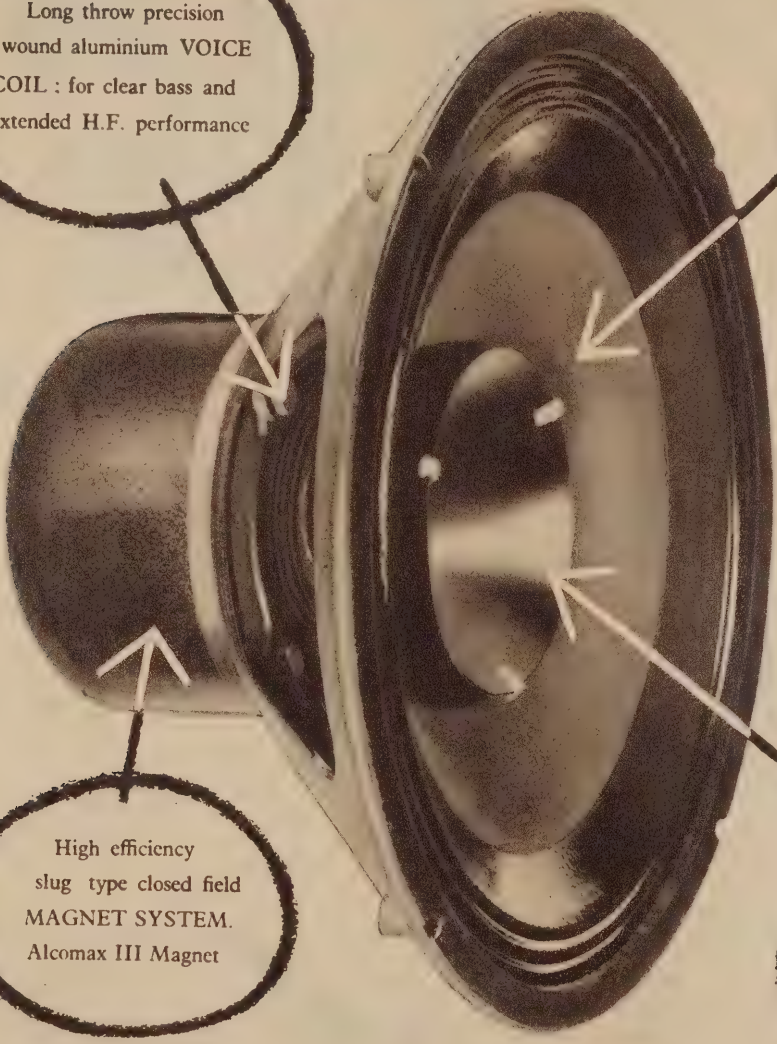

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"TUBE CAR" IS FASTER, CHEAPER

Economy of installation and operation is the objective of a new "aerial tube" train, currently being demonstrated at Chateauneuf-sur-Loire, France.

THE prototype car, illustrated at right and below, employs monocoque or "stressed skin" construction, making extensive use of aluminium and of other weight-saving techniques evolved by aircraft manufacturers.

It is just over 57ft long, 9ft 2in wide and 9ft 2in high. It can accommodate 123 persons for short runs, 32 sitting and 91 standing.

Unloaded, the complete car weight is 16 tons.

The car hangs from rubber-tyred bogie trucks running in an elevated tube.

Several advantages are claimed for this system. First and foremost, it is fundamentally safe at high speeds, because the car can sway naturally as it rounds curves, but it cannot roll over and it cannot leave the tracks.

It is claimed that the cars could operate at average speeds of up to 75 m.p.h. and maintain a frequency of service as high as one train unit every 90 seconds.

Though only a single car is pictured here, it is pointed out that cars can be assembled into complete trains

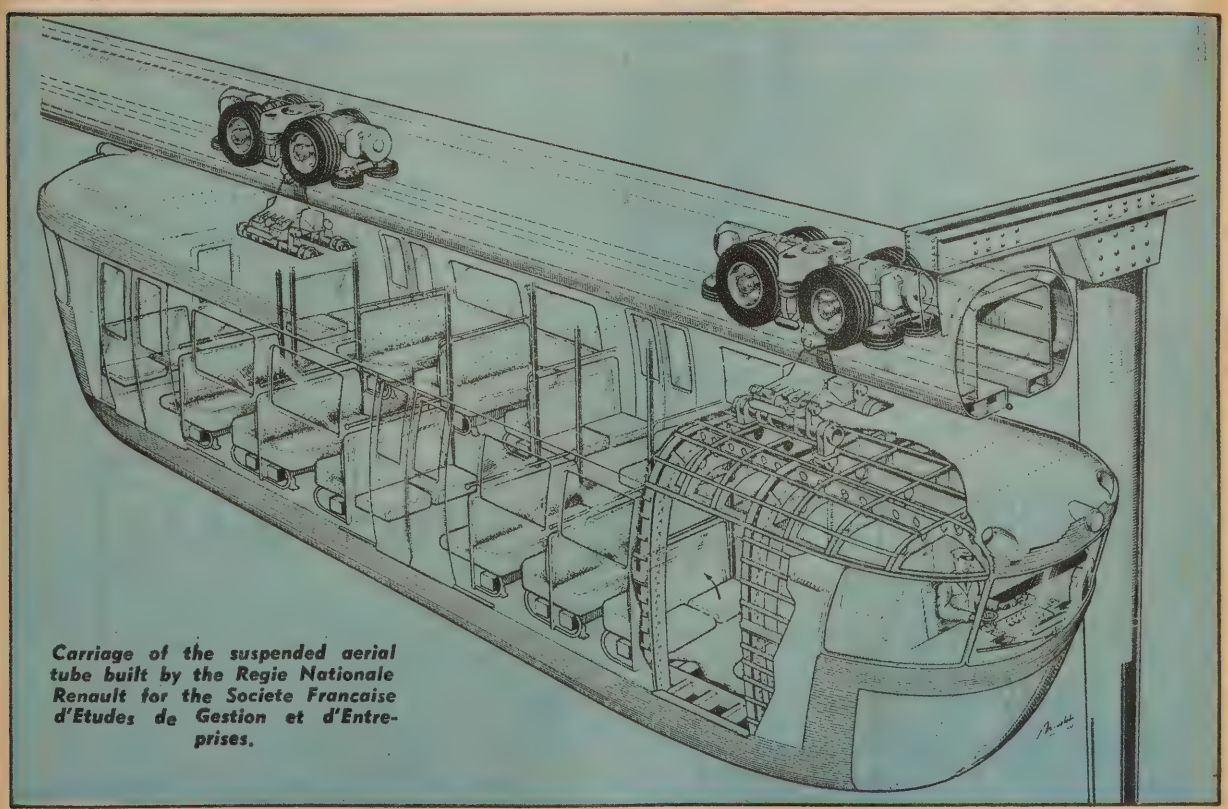
A further advantage claimed is that the running track, the bogie trucks and the power and signalling are all protected from the weather, as against the high degree of exposure experienced with conventional rail systems. This could, in the long run, add up to big savings in maintenance costs.

As illustrated below, the car is carried on rubber-tyred bogies, four large wheels supporting the weight and four smaller wheels giving directional control, against the sides of the tubes. Electric traction motors are part of the bogie assembly and therefore completely external to the passenger car.

It is estimated that the cost of a suspended tube railway system would be between 12 to 15 million francs per kilometre, against a figure of 70 to 100 million francs per kilometre for an underground system using conventional construction methods.

The car is suspended from two electrically powered bogies riding inside a giant "curtain rail." Very little running noise is transmitted into the car.

Inside the carriage currently being demonstrated at Chateauneuf-sur-Loire.



Carriage of the suspended aerial tube built by the Regie Nationale Renault for the Societe Francaise d'Etudes de Gestion et d'Entreprises.

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MISSILE UNIT FOR WILLIAMTOWN

The R.A.A.F.'s first surface-to-air guided weapons unit will be assembled at Williamtown in a few months. Eventually missile units will be used to guard all Australian capital cities and industrial centres.

By Arthur Scholes

THE missile unit costs about £4-million. It is a complete weapons system, including tactical control (making the fullest use of existing surveillance radar environments), target-illuminating radar, launch control posts, launchers, and fully engineered handling, servicing and test equipment.

These elements together form a largely automatic defence system which is self-contained except for the need to receive early warning.

The system can be employed either to provide a barrier type of defence for an extended area or perimeter defence of a more compact area.

☆

"Bloodhound" defence units are portable and self-contained. A missile mounted on a rubber-tyred trailer is shown here being loaded into a cargo plane.

☆

TO START SOON

Air Force personnel will begin to assemble at Williamtown in the latter half of this year, and the unit will be completely equipped by the middle of 1961.

No missiles will be fired from Williamtown, but tests of equipment and firing of missiles will be made at Woomera.

About 75 officers and men, most of them highly trained technical personnel, will be required to man and maintain the unit.

Arrangements have been made for R.A.A.F. personnel to take part in practice firings of the missiles, in Britain, as well as at Woomera.

The overall cost of establishing the missile defence of Australia's key centres will be £60 million.

The missile defence is part of the £600 million three year defence program announced by the Federal Government last year.

After training at Williamtown, the first Bloodhound surface-to-air guided missile station will be established at Beacon Hill, Sydney. Other missile stations will be at Newcastle, Port Kembla, and other capital cities."

The Bloodhound missile units are transportable. They can be driven into the holds of R.A.A.F. cargo planes and set up in other sites.

In overseas countries, rocket batteries are a feature of the local scenery.

In flight the Bloodhound is a "semi-active homing missile." It is guided towards its target by a radar beam projected from the ground at the target and reflected back to the missile.

Any evasive action taken by the target plane is useless. The robot has movable wings giving it a quick response to any change of direction in flight.

Solid fuel for the Bloodhound's four booster rockets will be made at Maribyrnong in Victoria. Its ram-jet engines use ordinary kerosene, similar to household kerosene.

This is non-explosive and no special precautions have to be taken in storing and loading the missiles.

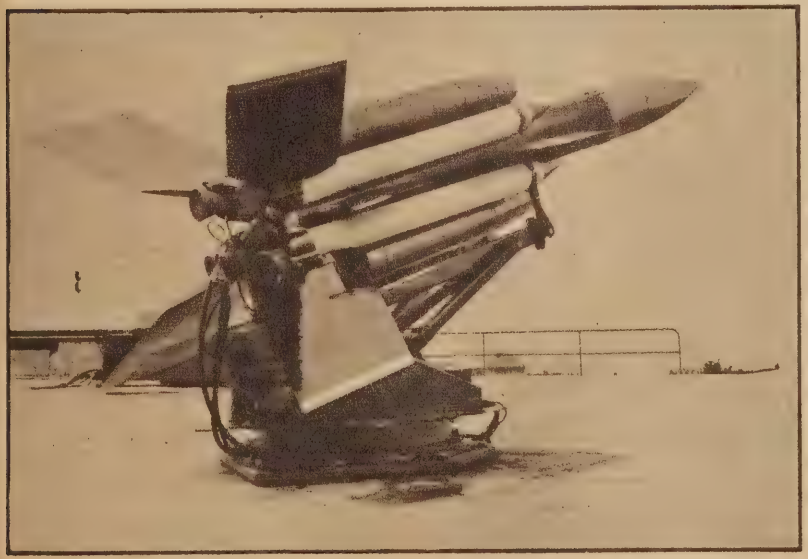
The Bloodhound was tested at Woomera where it has blown up Jindivik pilotless target planes at heights up to 60,000 feet.

KEY ROLE

The Bloodhound missile defence system is in service with the R.A.F. and has been given the key role in the air defence of the United Kingdom.

A developed version of the missile with greater lethality at increased range and altitude, as well as improved performance against low flying targets, will be supplied to the R.A.A.F.

Bloodhound, a weapon of advanced design and proved lethality, is claimed by its makers to have the longest range of any semi-active homing missile in the western world.



Missile launching centres are becoming part of the scenery in Europe. "Bloodhounds" have a key role in the defence of the U.K.

TELEVISION IN 3-D

THREE-DIMENSIONAL television for use in industry be shown at the Instrument, Electronic and Automation exhibition to be held at Olympia on May 23. Developed by Pye this new 3-D system can be attached to any existing closed-circuit TV installation.

This is the first time in Britain that a 3D television picture has been made possible when using only one chain of closed-circuit TV equipment.

A Pye master slave manipulator can be used in conjunction with the new 3D equipment for remote handling. The operator, having stereoscopic vision, can pick up any article by remote control. The three-dimensional effect is obtained by a mirror beam splitting system at the camera position and an arrangement of mirrors at the monitor end.

The volcano Selamat towers 11,000 feet above central Java. It is estimated that volcanic explosions have killed 130,000 Indonesians since the year 1800.

Much To Learn Yet About Volcanoes

Every now and again we have news of an eruption of a volcano in some part of the world. Great interest centres on the various phases of the eruption, the seismic activity, possible earth tremors or actual quakes, the explosive eruption or the flow of lava and finally the subsidence of the eruption and the return of the population.

THIS last is a remarkable tribute to the persistence of the human being that he always goes back to his home on the slopes of a volcano, notwithstanding the ever-present danger of eruption. Sometimes his home is destroyed, but he builds again and again and may begin anew several times during his lifetime.

At every major eruption, one finds geologists, chemists, physicists, vulcanologists, and so on, studying and gathering data relating to the eruption. For, notwithstanding the fact that there have been volcanoes during the whole history of the earth, man has never succeeded in understanding fully the causes of volcanic eruption.

Many theories have been put forward, but most of them have progressively been discarded. It is not so much the presence of hot gas and liquid rock which attracts thought. It is the problem of why, after possibly a period of many years of quiet, a volcano suddenly erupts.

There are other types of volcanic activity which are also interesting, such as geysers, hot springs, steam vents, boiling mud lakes and so on. We will touch upon these during this little discussion.

It has been estimated that there are about 600 active volcanoes at present distributed over the earth's surface in a well-defined belt. In addition, there are several thousands of inactive or dormant volcanoes and those which are extinct.

FORMATIVE STAGES

During the formative stages of the earth, millions of years ago, great strains and stresses were set up as the earth cooled down. This resulted in the formation of faults, or fractures, in the earth's outer crust.

These fractures and "folding" of the earth's crust seem to lie in belts, principally ocean basins, and the area bordering them and the ranges of mountains surrounding the continents.

The belt which has the most marked activity surrounds the Pacific Ocean. It passes through the Andes mountains on the west coast of South America, through the western parts of U.S.A., Canada, Alaska, where it turns west through the Aleutian Islands to Asia then south through Japan, the Philippines, North Hebrides, New Zealand down to South Victoria Land.

It will be noted that Australia lies just to the west of this belt, which is very fortunate for us.

Inside this circular belt there are a number of active volcanoes, notably in the Hawaiian Islands.

EAST AND WEST

Another belt runs east and west through the West Indies, the Azores and Canary Islands. It goes through the Mediterranean Sea, where lie Vesuvius, Stromboli and Etna, through Asia Minor and Arabia along the East Indies and out into the Pacific Ocean.

Of these two belts of activity, the Pacific Ocean belt is by far the greatest, having within its area three-fifths of the world's active volcanoes. Most of the Pacific islands, other than coral islands, consist of volcanic rock and soil, while many of the islands contain active volcanoes or other volcanic activity.

The name volcano is derived from a Latin word, "Vulcanus," which had something to do with Vulcan the god of fire of the ancient Greeks and Romans.

A mountain which belched smoke was the chimney of Vulcan's forge. The idea applied particularly to a small island in the Mediterranean, from which emerged noises like the blows of a mighty hammer on a steel forge, together with smoke from its volcano. This was thought to be the actual workshop of Vulcan, although nobody gave a satisfactory explanation of what he might be manufacturing!

The island was named Vulcano and is still active, although not so well known as other volcanoes in this area.

Many superstitions attached to volcanoes made them places to avoid, even by the philosophers of the day.

Nevertheless, Greek writers tried to give some explanation of volcanic behaviour. Plato, for instance, reckoned that rivers of fire deep in the earth heated up trapped air and that the resultant expansion brought about sufficient pressure to force the earth's molten interior to the surface. This was not a bad theory for the times and could be good enough today, with certain modern modifications.

Aristotle had a theory of rushing winds which became "pent up" in some way, which resulted in escape of molten rock through the volcano.

The modern geologist has learned a lot about the earth and, with the aid of instruments, has been able to get some

by **Calvin Walters**

light on the nature of the interior of the earth.

The earth has a radius of about 4,000 miles, with the outer 40 or 50 miles of solid material, known as the crust.

Obviously, no man has ever penetrated to the centre of the earth or even much more than a few miles below the surface by means of wells, mines and tunnels. Nevertheless, such penetrations have given some information which has been useful in determining what temperature the centre of the earth might be.

It has been shown that, on an average of different locations, the temperature increases about one degree for every 60 or so feet in depth. Working on this and making allowances for the contingencies which scientists like to allow for, it seems that at a depth of 30 miles the temperature might be 4,000 degrees Centigrade.

VERY HOT INDEED

Now this is pretty hot and, working on the same basis, it can readily be seen that the centre of the earth must be a very hot place indeed, with everything there in a molten state.

It seems pretty certain that nothing down there could be a solid as we know a solid. It must be a liquid, but whether it is a liquid liquid or a solid liquid is a matter of contention.

This statement might seem a bit silly, for how can we have a solid liquid. You might give ice as an example, but this would be wrong. Ice is a solid, but let's get on a bit further.

We cannot imagine anything at such temperatures as must exist at the centre of the earth as being anything else than a molten mass.

However, the instrument used for recording earthquake waves, known as the sesimograph, shows that there are waves which travel through the earth's centre in the same way as they would travel through a solid mass, which is quite different from the way they would travel through a liquid.

How then can we reconcile this?

The only theory scientists can think of at the moment is the following: The temperature is such that the mass must be a liquid, but because of the great pressures which exist at the centre by means of the overlying rock and solid crust, the mass has no room to expand and is therefore kept rigid.

ENORMOUS PRESSURE

In order to melt, a mass must have room for expansion and, according to well-known laws of physics, substances are liquids, solids or gases according to the pressure and temperatures involved.

At distances of 10 miles below the earth's surface, the pressure has been estimated as being some 30 tons per square inch. What, then, must be the pressure below the 40 or 50 miles of crust?

Now before we proceed further, there is another thing which scientists do not know much about. They do not know what produces the great heat inside the earth. They do not know whether it is residual heat bottled up from those great explosive days when the earth was born.

They do not know whether disintegration of the mass by radio-activity is the cause of the heat or whether it is generated by the great pressures involved, for we know that great pressure will produce heat.

It doesn't matter much for our purposes, for we are only really concerned that the heat is there and we want to know what it has to do with volcanoes.

If we now agree that the centre of the earth is a solid liquid, as explained above, we have something to work on.

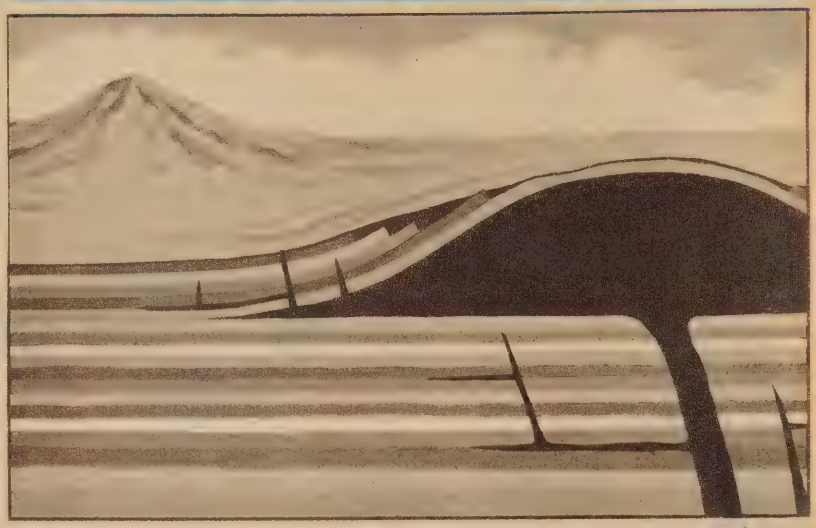
CRUST IS CHANGING

Geologists agree that the crust of the earth is changing all the time. Downward and upward movements are taking place, but whether this is caused by shrinkage is still a matter for argument.

The latest theory is that these movements are not caused by shrinkage as the earth cools down, as was previously thought, but by the downward pressure of the heavier rock formations which force themselves down while forcing the smaller rocks up by displacement. Whatever the causes, we know that these movements are occurring and create weaknesses in the earth's crust.

Thus at places where there are weaknesses, the internal pressure is relieved to an extent which allows the "solid liquid" core to assume its liquid form and this oozes up through the crack or fault until it finally emerges to the surface in the form of molten lava.

MOLTEN ROCK FORMS LACCOLITH



Molten rock, pushing upwards, has displaced stone beds without breaking the surface. This is known as a laccolith.

A volcano is thus born, the eruption of which can take many forms.

When the pressure is sufficiently relieved and a certain amount of lava has been discharged, the volcano may subside, never to be heard of again, or it may continue to erupt for months, gradually building up the characteristic cone-shaped mountain from the debris and ash emitted from its interior.

After a period, a volcano may become dormant, with the residual lava solidifying in the crater. The volcano may then lie dormant for centuries, but should always be treated with suspicion, for the term dormant means it is only quiet and inactive. Seismic activity may still exist

This sketch shows a section through a typical geyser cone. Water is turned into steam deep in the earth and the resulting pressure, building up periodically, causes the geyser "eruption."

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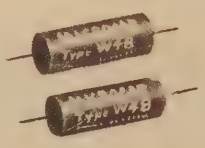

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LAVA LEAVES TRAIL OF DISASTER

beneath, which can be detected by modern instruments.

With such a volcano, pressures may build up again because of internal activity in the form of gas pressure. Water may seep into the internals, where it is converted into steam under enormous pressure.

In such circumstances, the pressure may be greater than the solid plug of lava in the crater may stand and the volcano may blow up with the force of an atom-bomb. Or new craters may form at short distances from the original, through weaker points in the crust.

An extinct volcano is one where the eruption has ceased and the lava has solidified to such an extent that it forms a solid barrier to the flow of further lava. Instruments show that no seismic activity exists in the vicinity of an extinct volcano.

MOLTEN ROCK

The lava which flows from a volcano is molten rock. While it is in the earth in a molten state it is called "magma." It only becomes lava when it flows from the crater.

There are various forms of chemical reactions associated with an eruption, with the formation of the gases of steam, water vapour, hydrogen, sulphur and various hydrocarbons. It is the combustible gases of hydrogen, sulphur and hydrocarbons which produce the flames emanating from a volcano.

While it seems that, all over the world, the original magma is molten basalt, there are differences in the composition of the lava from different volcanoes, which have not been satisfactorily explained.

For instance, the same volcano may emit different kinds of lava at different times. The lava from Mount Vesuvius is totally different from that from Mount Etna, in the same region. This is yet a mystery, in view of the foregoing statement that all magma is basalt.

REALLY STEAM

What at first sight appears to be a great cloud of smoke coming from the crater of a volcano is really steam coloured by very fine dust particles mixed with it by the force of the explosion. This steam turns to rain sooner or later and falls on the surrounding countryside in the form of mud, which may be heavy enough to cover farmlands and nearby houses.

Other chemicals formed by the eruption include carbon dioxide, hydrofluoric acid, hydrochloric acid, hydrogen sulphide and sulphur dioxide.

When the magma is under great pressure it is capable of absorbing great quantities of gases. As the pressure forces the magma up through the crevices of a volcano, the pressure is relieved and the gases form bubbles within the magma.

It therefore becomes progressively lighter and more bulky as it rises, which fact in turn causes an increase in the velocity of the upward flow. As the gases are released, they may alternatively rise in advance of the magma and blow passages through the weaker crevices, from which the lava finally emerges.

Of the solid materials emitted at the time of an eruption, there are the "fragmental products" which consist of rocks broken away from the walls of the crater or carried up on top of the advancing magma from passage ways in the earth. There are also pieces of solid lava from previous activities and pieces of liquid lava thrown into the air by the explosive forces, where they harden and fall to the ground as solids.

A typical trail of destruction caused by a lava flow, in this case in the Philippines. The wonder of it is that people return to such areas immediately the eruption is over, to rebuild their homes and plantations.

These fragmental products are classified by scientists as "blocks" if they are over the size of an orange and emitted as solid pieces and "bombs" if they were first emitted as liquid magma. "Lapilli" are pieces the size of walnuts. Those the size of a pea are volcanic ashes. Finer pieces are volcanic dust.

Sometimes those the size of a pea and the volcanic dust are grouped together under the name of "scoria." Then there is volcanic sand which is granulated lava.

There is a type of rock which geologists call "igneous." The Latin word from which this is derived means that these rocks were once hot and formed at high temperatures. According to the chemical composition of the magma from which they were formed and the speed at which it solidified, so the texture of these igneous rocks varies.

MOSTLY SILICATES

Magma consists mostly of silicates and they are named according to the amount of silicates they contain. The different types form different rocks.

There is the "silicic" magma which hardens into granite and rhyolite. Then there is the "intermediate" magma which forms diorite and andesite (the latter found in the Andes Mountains, hence the name). Finally there is the "basic" magma which forms basalt and gabbro.

Other products of volcanic eruptions are glasses which are combinations of silicas and other chemicals. There is a lustrous volcanic glass called obsidian and another called pitchstone.

The well-known pumice stone is a glass frothed up by gases and hardened in the air like honeycomb toffee.

Many of the formations of hills and mountains were formed by upward flows of magma which never reached the surface. The enormous pressures forced the magma upward, lifting with it the overlying layers of sedimentary rocks. The pressure was not sufficient for a break-through and a large hill was formed.

RESTING ON SOIL?

When this mass of lava does not rest on a known floor of rock it is called a "batholith," meaning stone of great depth. If the magma is resting on a floor of rock, having forced its way between layers and lifted the upper layer it is called a "laccolith" or lake of stone.

Some of these formations are very large, one batholith in British Columbia measuring over 100,000 square miles in area.

Mention was made earlier of geysers and hot springs. These are spectacular phenomena found notably in New Zealand and in the Yellowstone Park in U.S.A.

These geysers are smallish holes in the ground, sometimes surrounded by a small cone of volcanic material. Every now and again they emit jets of steam or hot water which is thrown many feet into the air.

Some of the geysers perform with almost perfect regularity, having a regu-

(Continued on Page 127)

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Technical Review

A DEFINITION SYSTEM FOR COLOUR, HUE, SATURATION

Fanciful names for colors are apparently considered necessary by paint manufacturers but the terms are scientifically quite meaningless. In an effort to rationalise color definitions, the U.S. National Bureau of Standards has evolved a system of color blocks, to be described in simple, unambiguous terms.

THESE blocks are defined as segments of a solid figure, each segment encompassing the range of colour acceptable under one colour name. Fitted together, the segments comprise the psychological colour solid that scientists use to explain graduations in colour perceived by the human eye.

The central notations of the blocks have been designated in terms of the Munsell tridimensional scales, and paint-on-paper prototypes of the centroid colour of each block are being produced.

After the prototypes have been approved by the I.S.C.C. (Inter-Society Colour Council) and N.B.S., the bureau plans eventually to reproduce the colours as a colour-chart supplement to N.B.S. Circular 553, the I.S.C.C.-N.B.S. Method of Designating Colours and A Dictionary of Colour Names.

First published three years ago, Circular 553 is now in its third printing. It is employed as a tool by the scientist, the businessman, and the layman to correlate the thousands of different names given to colours by art, science and technology. These colour names are listed in the circular under headings derived from the colourname blocks.

The varied applications to which the circular has been adapted by the general public have created a need for a colour chart to illustrate the blocks. The present study was therefore made to determine the block centroids from which representative colour samples could be produced.

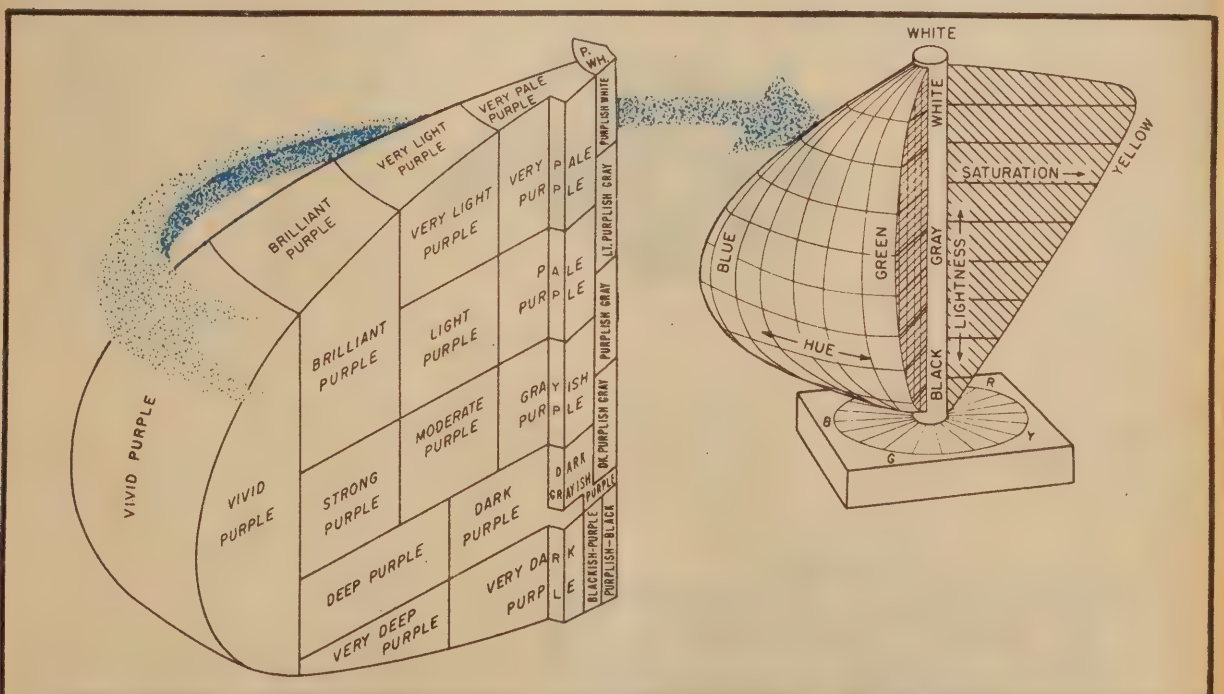
In making the computations, the I.S.C.C.-N.B.S. method of designating colours was followed. In this method, the psychological colour solid is visualised as a lopsided grapefruit with an irregularly indented outer skin.

Its vertical core is white at the top, black at the bottom, with the intermediate greys in between.

The characteristic of colour varying along this vertical axis is known as lightness; it indicates how dark or light the colour is, and is measured by Munsell value.

The second characteristic of colour is known as hue. Hue is indicated by the name given to a colour, such as red, yellow, green or blue. These four spectrum hues, plus the nonspectrum hue, purple, are thought of as evenly spaced around the equator of the grapefruit in accord with the Munsell hues scale.

Elsewhere in the solid are places for all the possible colours; light ones near the top, dark ones near the top, dark ones near the bottom; and



Artist's conception of the psychological color solid used in the color-measurement study. One quarter of the solid is removed to show the vertical axis. On the left is a segment of the solid from the purple area. Its color-name blocks reflect varying degress of hue, lightness, and saturation.

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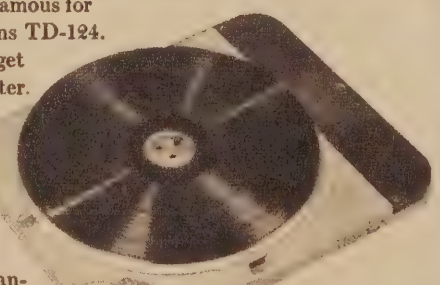

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the greyish colours surrounding the greys at the core.

Saturation, the third characteristic of colour, indicates the departure of a colour from grey. This quality is measured by Munsell chroma which gives the distance of the colour location in the solid from the core.

The most saturated or strongest colours are located on the skin. Those with little saturation, such as purplish black, purplish grey, or purplish white, lie along the core or vertical axis.

In the I.S.C.C.-N.B.S. method of designating colours, a set of simple, unambiguous hue names is utilised. They are combined with modifiers to form combinations such as light blue, dark red, moderate yellow green and vivid pink.

The complete set of colour names including white, the greys and black totals 267, and the names may be used to describe any colour.

NOT CUBES.

The colour-name blocks are not cubes; the inner blocks are composed of sectors of cylinders. It was therefore necessary to use a mathematical formula in terms of Munsell hue, value and chroma to determine the numerical designations of the centroids.

With the formula, the centroid of a single or one-component block could be calculated from its hue, value and chroma ranges.

However, to find the centroid of a compound or two-component block, the volume-weighted mean of the central notations of the two components had to be computed. The resultant centroid lies on the straight line joining the centroids of the component blocks.

For a three-component block, the centroid for two of the adjacent blocks was found, and then combined by the same method with the centroid of the third block. The value notation of the resultant centroid was computed as the volume-weighted mean of the value notations of the three separate centroids.

The formula is not applicable to colour-name blocks that intersect the irregular outer surface or skin of the colour solid. For these blocks, the centroid was estimated graphically.

When the centroid colour samples become available, they will be made into special charts for the use of a committee of the Inter-Society Colour Council which is investigating historical colour usage. The centroid colours may ultimately be incorporated as an appendix in a second edition of N.B.S. Circular 553.

REFERENCES

For further technical details, see Central notations for the revised ISCC-NBS colour name-blocks, *by K. L. Kelly, J. Research NBS 61, 427 (1958) RP2911.*

A colour notation, *by A. H. Munsell, 10th ed. (Munsell Color Co., Inc., 10 East Franklin St., Baltimore 2, Md., 1954).*

Dictionary of colour names, *NBS Tech. News Bul. 40, 22 (1956). NBS Circular 553 is available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. 2 dollars (2 dollars 50 cents foreign).*

REVIEW—BRIGHT FUTURE FOR THE TUNNEL DIODE

One of the most interesting semi-conductor devices developed in recent years is the Esaki tunnel diode. (See R, TV, & H, December 1959.) As top engineers from the world's electronic firms investigate potential applications, its future looks extremely bright. In particular, operation in the kilo-megacycle range seems assured.

LEO ESAKI observed that in a p-n junction of a semi-conductor, when there is an internal field, electrons tunnel between the conduction and valence bands. Further, tunnelling decreases over a range of forward bias due to the relative displacement, with bias, of the energy band on opposite sides of the junction.

Ever since this tunnelling effect was first made known to research, important semi-conductor men have been actively investigating the tunnelling electron and mechanical techniques for diode fabrication.

Frequency response in the ultra-high and super-high frequency bands (uhf is between 300-3,000 mc; shf is between 3,000-30,000 mc) with simple circuitry; low noise figure; ability to operate from near absolute zero to several hundred degrees C; and remarkable resistance to radiation damage. These are some of the features of this development — some actually worked out in devices, all working on paper.

HOW HIGH?

One question presently being asked by many top semi-conductor research men is: "How high up in frequency can the tunnel diode go?" And they are beginning to answer this question themselves.

How high is up? The frequency is going up steadily, whether for amplification or oscillation, and nothing imposed by the Esaki tunnelling process says it will stop. Of course, mechanical techniques of construction are to be solved. And indeed, the principal problem seems to be one of fabrication — the assembly of parts of small dimension.

Semi-conductor men are now obtaining a better understanding of the device and its high frequency response. Last year, RCA announced a tunnel diode made of germanium that would operate "higher than 1,000 mc and had potential up to 10,000 mc" (ELECTRONICS, p 69, July 10). And on paper, GE admits it can get up to 10,000 mc and beyond.

BELL'S EXPERIMENTS

Bell Laboratories has done a lot of work with tunnel diodes, but so far has not published many of its important findings. Bell is interested in switching devices, and present research uses indium anti-monide cooled to a low temperature.

Henry Sommers, one of the key semi-conductor men at RCA, feels confident that inside of a year various laboratories will be up to 10,000 mc. At room temperature there may be difficulties in operating around the 10,000 mc mark. But going up higher at reduced temperatures will involve questions of technique.

Just how many technique problems are solved, the various labs working in this field are not ready to admit, right now. But we can guess. And one thing is sure. This year will be a big one for microwaves.

One actual report of tunnel diode research at IBM, investigating the Esaki effect as a possible computer element, is reported by R. F. Rutz. Two factors in this development should be noted. First, experimental oscillators have been fabricated from germanium with fundamental oscillations that have reached into

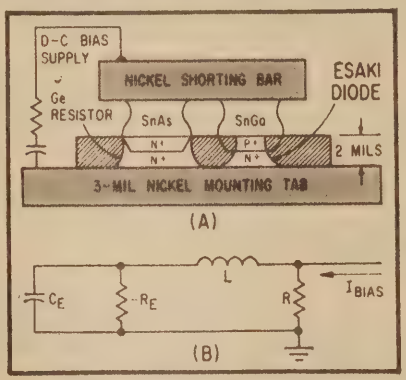

FIG. 1—Schematic cross section of the semi-conductor microwave oscillator (A), and its simplified equivalent circuit (B). Experimentally, the frequency increases as the diameter of the Esaki-diode junction area is decreased.

the super-high frequency band: 3,010 mc and 4,020 mc. These are believed to be the highest frequencies of oscillation for the Esaki diodes yet reported.

Second, the design approach uses lumped-parameter components — inductance, capacitance and resistance. Fig. 1B gives the simplified equivalent circuit of the semi-conductor microwave oscillator.

The IBM unit is a neat and well designed integrated circuit package, putting the tank circuit inside the mount. Eventually these devices will all come to having the circuit and device packaged together.

According to Rutz's description, the lumped-parameter oscillator, Fig. 1A, consists of a highly doped n-type germanium wafer soldered to a mounting tab which serves as one electrode of the circuit. Two tin impurity dots, one doped with gallium, the other with arsenic, are alloyed to the n-type wafer in close proximity.

The SnGa dot forms a recrystallised p region which makes an abrupt junction with the heavily doped n material. This produces a negative resistance of the Esaki type when a forward bias in the region of 50 to 350 mv is applied.

OSCILLATION

The SnAs dot, on the other hand, merely forms an ohmic contact to the n-type wafer. If the resistance between the SnAs dot and the mounting tab is smaller than the absolute value of the negative resistance of the Esaki diode, then the system oscillates at a very high frequency when a shorting bar, which acts as the second electrode of the circuit, is connected as shown.

A biasing current then flows through the resistive part of the circuit of sufficient magnitude to produce d-c voltage across the Esaki diode to make it behave as a negative resistance.

The Esaki part of the circuit is represented in Fig. 1B by a negative resistance — Re, shunted by a capacitance, Ce. The bulk resistance of the diode is not explicitly represented in this simplification, says Rutz. The bias resistor, concentrated under the SnAs dot, Figure 1A, is represented by R and the loop inductance of the circuit is represented by L. A necessary condition for oscillation is that R less than the negative resistance –Re.

RADIO AIDS TO MARINE NAVIGATION

"Old Salts" from the days of sail would surely turn in their graves if they had an inkling of the scientific aids which are taken for granted by the modern sailor. A typical example is this account of the equipment Marconi Marine recently installed in the new bulk cargo carrier, "Athelprincess."

BUILT at Dundee by Caledon Shipbuilding and Engineering Company, Limited, for Athel Line Limited, Athelprincess employs an "Oceanspan VII" transmitter and an "Atalanta" receiver, providing full radiotelephone/telegraph facilities including a remote telephone deskset in the captain's day-room and an extension loudspeaker in the wheelhouse.

The emergency installation consists of a "Reliance" transmitter, an "Alert" receiver and a "Salvita III" portable transmitter/receiver for use in any of the lifeboats. The radio cabin installation is completed by a "Seaguard" automatic alarm and an "Autokey" automatic keying device.

The new vessel's electronic aids to navigation include a "Radiolocator IVA" radar installation with 9in display unit, "Lodestone IV" direction finder with compass repeater fitting, and "Seagraph III" dry-paper recording echometer with an auxiliary "Seavisa" visual indicator.

Eight MIMCO cabin receivers are provided for broadcast reception and a "Pantenna" communal aerial system serves 52 cabins. A combined order and alarm system has also been installed, employing a MIMCO amplifier and 12 loudspeakers, which replace the normal alarm bells and are grouped so that orders can be passed to any selected area of the vessel's accommodation.

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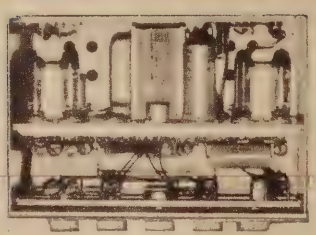

UNIT "A" Chassis, sub chassis, control channel, rear plate, front panel, cover, perspex escutcheon plate, panel screws, name-plates, hardware, template, descriptive leaflet with wiring diagram and assembly details.

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REVIEW—INVESTIGATING MYSTERY RADAR ECHOES

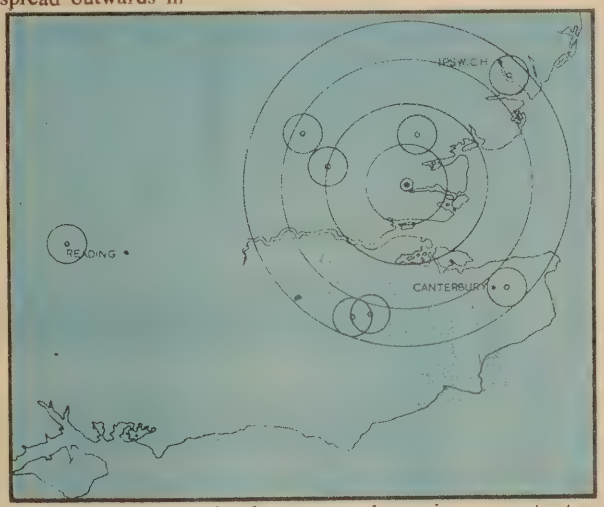
In the frequently picturesque language which radar engineers have inherited from their wartime predecessors an "angel" may be defined as an indication on a radar screen of an "echo" from some unidentified object. In normal times these are of passing interest only and for the most part are capable of being logically accounted for.

By their thousands, starlings roost for the night in certain areas, rising as a flock at dawn. Engineers-cum-bird watchers, using portable radio-telephones, are attempting to relate their movements to mysterious patterns on radar screens.

BUT for the past year the radar engineers at the Marconi Research Establishment at Great Baddow, Essex, have been studying a new form of "angel" which is as puzzling to explain as it is impressive in appearance.

They have developed a technique at Baddow for the precision recording on cine film of the "picture" displayed on a radar screen, that permits the transient phenomena to be the subject of later reproduction and study at leisure.

In using this technique for other investigations the radar scientists first noticed an "angel" which behaved in a most unusual manner. Starting, like any other, as a spot of light, it spread outwards in the form of a ring, as a ripple spreads on the surface of a pond into which a stone has been dropped and, as on the pond, it was followed by another and another, each spreading from the same centre and fading out. This occurred at dawn and when the phenomenon was repeated a day or two later a thorough investigation was organised.



A few of the seventy locations in South-East England identified as being centres of the "Ring Angel" phenomenon. All the rings observed by Marconi investigators have occurred at sunrise and in a variety of weather conditions.

No completely satisfactory explanation of all the features of these "ring angels," as they have been christened, has yet been found. Observations over some months established the fact that they occur only within half an hour before or after sunrise.

A weekly "angel watch" has been maintained and about 70 places, spread all over south-east England, have been identified as being centres of repeated but irregular occurrences of the phenomenon. Some of these centres are near big towns like Ipswich and Reading, others are in the open country.

The confinement of their occurrence to the hour around sunrise suggests two possible lines of investigation.

Flocks of starlings, for example, are widely recognised as being the cause of a high percentage of ordinary "angels." Leaving their roosts they may produce echoes in the form of short circular arcs. But sequences of complete circles, expanding as they do at speeds ranging from 20 to 50 miles an hour, do not seem to be so easily explained on these lines.

The other possibility under consideration is the proposition that the thermal redistribution of the atmosphere at sunrise may be at the bottom of these apparitions. Radially expanding fronts might well occur, of which the speed range would correspond with that indicated by the radar rings.

But no one can suggest a satisfactory explanation of how any type of atmospheric front might cause a radar echo having the requisite amplitude to be detected, even by hypersensitive equipment in use which can, in fact, give evidence of the radio "noise" emitted by the sun.

For this reason the bird theory has grown in favour and the prolonged study continues with a view to establishing the common factors, if any, between the characteristics of the rings—in terms of geographical position, frequency of generation, velocity of expansion, the annual cycle of occurrence and so on—and those of the known or observable habits of the birds.

The nature and duration of the rings fortunately do not interfere in any way with the practical use of the radar and they are immediately distinguishable from normal "angel" phenomena.

Nevertheless, they present a challenge to the insatiable curiosity of the research man and, even though the interests of pure science may be for the moment apparently alone involved, the Baddow angel-watch will not let that challenge go unanswered.

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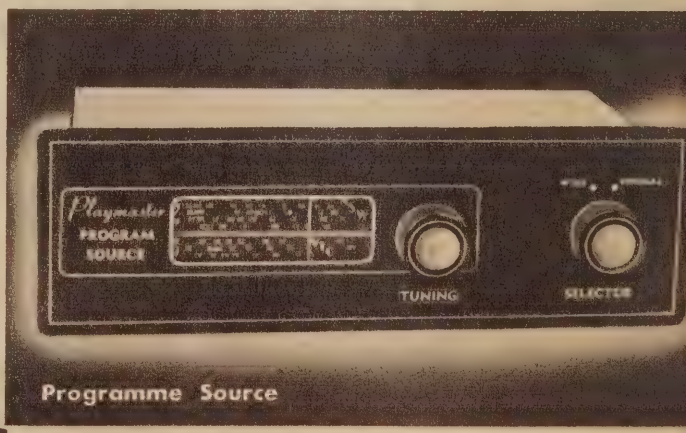

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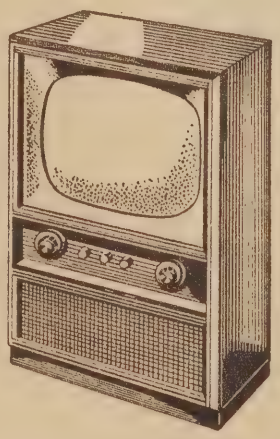

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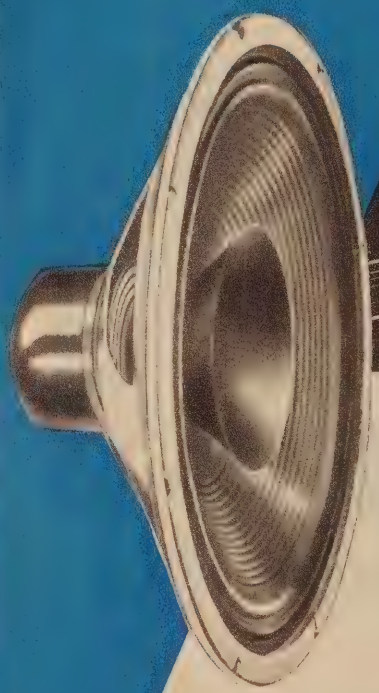

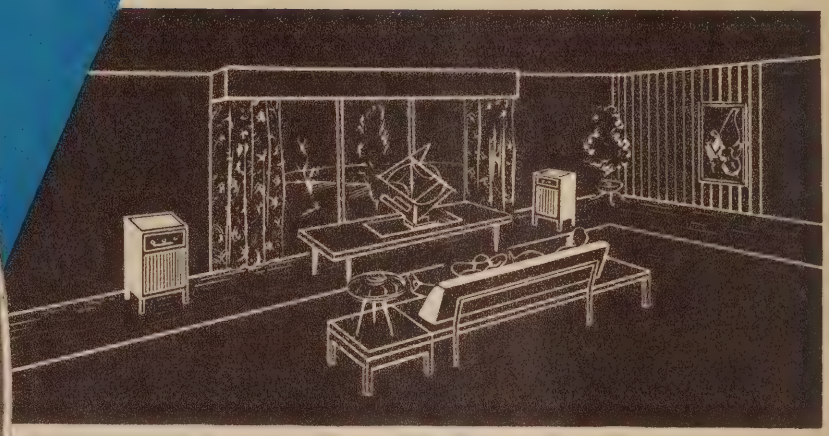

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Power Handling Capacity	20 Watts Peak
Diaphragm:	
Fundamental Resonance	50 cps
Frequency Response	45 cps — 12 kc
Voice Coil Impedance	15 ohms at 400 cps
Air Gap Flux Density	12,800 Gausses
Total Gap Flux	87,000 Lines
Principal Dimensions:	
Overall Diameter of Diaphragm Housing	$12\frac{3}{32}$"
Diameter of Baffle Opening	$10\frac{29}{32}$"
Diameter of Voice Coil	$1\frac{3}{4}$"
Depth from Pad Ring to Rear	$4\frac{3}{4}$"

ROLA COMPANY (AUST.) PTY. LTD.
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CALTEX HOUSE, KENT STREET, SYDNEY, N.S.W. BU 6147

NEWS AND VIEWS OF THE MONTH

New type deck chair

ANYONE who has tried to stow the conventional type of deckchair in the back of his car is likely to welcome the Portadeck, a new foolproof folding chair designed by a British engineering firm, and described recently over the B.B.C.

When folded its overall measurements are 2 feet 9 inches by 4 inches by 5 inches.

"You start by taking off the canvas," said the reporter. "It is held in place by top and bottom rails fixed to the main frame by simple dowels. You just lift the rails off, then roll them up in the canvas.

"Then, press the two long sides of the chair together—light metal straps linking the sides pivot to allow this to happen. Finally, you pull the top of the back down towards the foot of the chair. Total folding time comes to about five seconds."

Aid for paralysed

TO be deprived of reading when fit is bad enough, but for badly paralysed people it is an incalculable loss. Now a committee working under Duncan Guthrie, director of Britain's National Fund for Polio Research, has developed a new kind of projector that will help the paralysed to read just like other invalids.

Mr Guthrie said that this small, compact machine would stand beside the patient's head, the book would be on microfilm and it would be projected page by page on to a little screen about 18 inches or two feet in front of the reader.

Even virtually immobile patients would be able to control the machine, Mr Guthrie said. A patient could, if necessary, turn a page simply by pressing a very light switch with his tongue.

New radar

THE latest type of Decca air surveillance radar has recently been installed at Arlanda, Stockholm's new international airport. It is the first of three long-range, high-definition radars of an entirely new and advanced design which are being supplied by Decca Radar Limited for use at major Swedish airports.

Specially designed for use in areas of medium and high traffic density, where modern aircraft of the jet and turbo-prop type are operating, this new British radar type D.A.S.R.1 provides precise information on the location and movement of all aircraft within approximately 100 miles of the station up to heights of 40,000ft and above.

Technical advances have resulted in a very considerable improvement in the information renewal rate and picture clarity being provided by the new equipment, two essential factors for aircraft safety.

At Arlanda, Stockholm's new airport, which will come into full service during 1960, the Decca D.A.S.R.1 radar is installed on a tower 90ft high in wooded area south of the airfield. The system is entirely remote controlled, all displays and switch gear being fitted in the approach control room in the new airport terminal building.

Hot rugby

PLOUGH'S slicing into Edinburgh's famous Murrayfield ground may sound like sacrilege to Rugby football enthusiasts, but that is just what has happened recently. The ground has been electrified.

Special ploughs have laid wires 6in deep and 6½in apart from end to end of the famous pitch. There are 217 circuits altogether, with fuse boxes at both ends of the ground. The main control is under the stand.

Murrayfield is the first football ground in the world to be treated in this way and the company that has carried out the work is confident that it will make cancelled or postponed matches a thing of the past.

The groundsman will be saved many anxious moments wondering whether there is going to be a hard frost in the night, for the thermostatic control will spring into action when the temperature drops low enough, keeping the ground pleasantly fit for play, and will automatically switch off if the temperature rises.

Life-jacket for infants

A BRITISH firm which has pioneered many life-saving devices, such as Inflatable rafts, in the past 40 years has just produced the first life-jacket for infants.

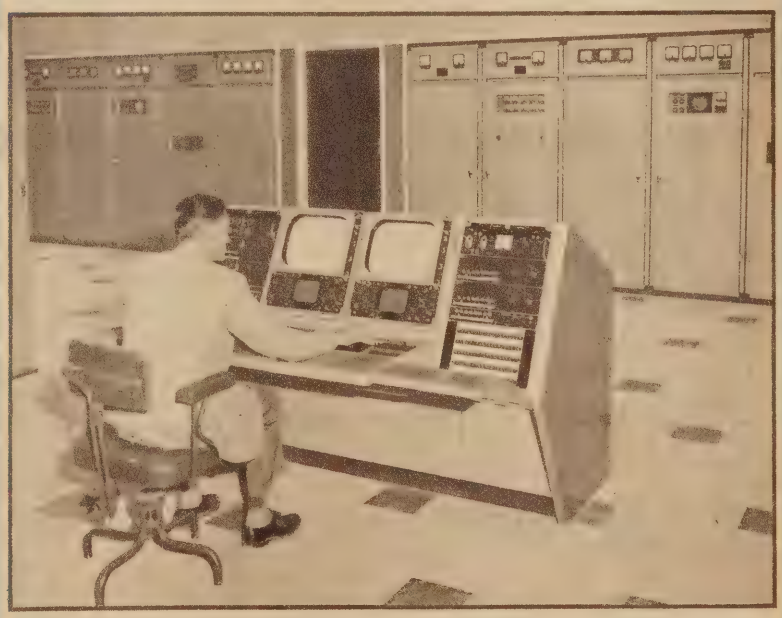
Designed for children up to four years old, it is made of rubber-proofed fabric and weighs just over 1lb. Normally, it is inflated automatically by a tiny cylinder of carbon dioxide gas in a second and a half. Alternatively, the person looking after the baby can quickly pump it up by hand.

There is a harness of the snap, hook, and buckle type which allows the child to be put into the jacket very rapidly in an emergency . And once in the water, the baby is comfortably supported—head well up.

Most important, there's no danger of the life-jacket turning over, or drifting away and getting lost at night. One of its unique features is an automatic light that shines brightly for 20 hours.

There is also a long life-line which can be attached to an adult.

ABS CHANNEL 2 NOW ON THE AIR



NEWEST arrival on the television scene in Australia, the A.B.C.'s Station ABS, Channel 2, came on the air recently, providing a national television service for more than half a million people in Adelaide and surrounding districts.

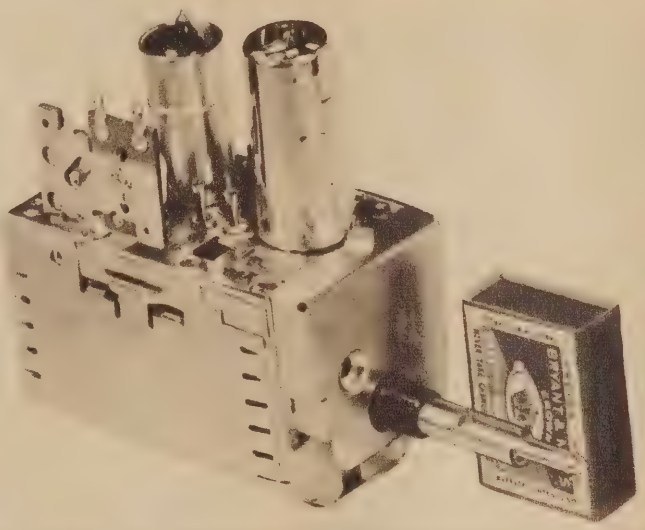
Situated at Mount Lofty, highest point of a range of hills to the east of the city, the site is marked by a 440ft tower, carrying the high-gain aerial array. Associated studios are situated at Collinswood.

The transmitters (vision and sound), aerial array, control console, combining units, program links, and a quantity of ancillary equipment have been supplied by A.W.A. in association with Marconi's of England.

This picture shows the control console with vision and sound transmitters in the background.

AMERICA'S TOP SELLING TUNERS
now to be made under licence in Australia

R. W. STEANE LIMITED ANNOUNCE THAT THEY WILL HAVE AVAILABLE IN THE NEAR FUTURE THE AUSTRALIAN MANUFACTURED WORLD FAMOUS STANDARD COIL PRODUCTS CO. INC. GUIDED GRID TELEVISION TUNER, WHICH WILL INCLUDE MANY NEW WORLD PATENTED EXCLUSIVE FEATURES, NOT PREVIOUSLY AVAILABLE IN AUSTRALIA.



LOOK!! ANOTHER R. W. STEANE LIMITED FIRST IN AUSTRALIA!

Now available: "IRISH" RECORDING TAPE

The only genuine AMERICAN PROFESSIONAL GRADE RECORDING TAPE in Australia that will pass even the most critical tests, because only "IRISH" tape is made under the exclusive FERROSHEEN process. This ensures highest professional standards and meets all EIA and NAB specifications.

See your wholesaler now! Others are enjoying a new high standard of Tape Recording, why not you?

IRISH TYPE 211 (ACETATE BASE) premium quality high fidelity tape at standard prices.

	RETAIL
600ft x 5in reel	25/7
1,200ft x 7in reel	44/7

IRISH TYPE 601 (MYLAR BASE) long-play premium quality tape with superior frequency response characteristics.

900ft x 5in reel	47/1
1,800ft x 7in reel	69/

IRISH TYPE 724 (Tensilised Mylar Base) double play specially strengthened high fidelity tape, which eliminates the need for gentle handling.

1,200ft x 5in reel	78/10
2,400ft x 7in reel	133/

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Stereo standard

THE rapid, world-wide adoption of sterephonic recordings has been recognised by the International Electrotechnical Commission with the publication of a recommendation covering dimensional features and recording and reproducing characteristics for this type of disc.

The purpose of this international standard, IEC Publication 98-1, Recommendations for Stereophonic Commercial Disc Records, is to ensure international interchangeability of records.

The recommendation is issued as a supplement to IEC Publication 98, Recommendations for Lateral-cut Commercial and Transcription Disc Recordings, which was published in 1958, and with which IEC 98-1 must be read.

Points covered in the new recommendation include groove dimensions, speed, diameters, thickness, label information, stylus tip radius, etc.

A section is included as explanatory matter on the stereophonic groove, which states that pick-ups designed for stereophonic reproduction will in principle be suitable for playing normal fine groove records, but that the majority of present-day pick-ups for single-channel operation have a stylus point radius that is too large for stereo records.

Cooking with a lantern

THE British-made Tilly Guardsman storm lantern has recently been adapted for cooking as well as lighting. Adrian Thomas described the unique conversion unit produced by the Tilley designers in a recent B.B.C. broadcast.

"You simply remove the heat-resisting glass globe on the storm lantern," he said, "and replace it—without using any tools—with the conversion unit, which consists of a shield that fits over the original flame source to form a burner with a circular bracket round it to put your cooking vessel on.

"Very little pumping is needed to keep a steady supply of heat, adequate for most of the sort of cooking that is likely to be done on picnic or safari or in temporary work camps.

"Another important feature is that the unit is fitted with an automatic internal cleaning wire which does away with the businesss of using a pricker to keep the jets clean.

"One filling of one and a half pints of paraffin gives 12 hours of light at 300 candle-power brilliance when the Guardsman is used as a lantern, or four and a half hours of cooking power when used for cooking. The lantern stands 13½in high and weighs 6½lb when filled.

TV aerial problem

DESIGN of the aerial for I.T.A.'s Dover transmitter, which began relaying programs of Southern Television recently, posed a difficult problem for engineers of E.M.I. Electronics Ltd.

Although 100 kilowatt signal was required to serve the one million viewers in the area, radiations in the direction of the French coast had to be negligible to meet international requirements.

To achieve this aim, the engineers developed a special array of full-wave vertical dipoles. A screening frame was used to ensure that radiations towards France were kept at the absolute minimum.

When test transmissions were made recently, it was found to be better than had been calculated.

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Case and panel are the same as last month. Only an extra terminal is required.

Square Waves For Audio Oscillator

Last month we described a most attractive, inexpensive but reliable and accurate audio oscillator. This month, we consider the calibration of the instrument and the addition, if required, of the necessary circuitry to provide a square-wave output.

By John Barker

THERE are two possible approaches to the problem of calibration. One is to accept as sufficiently accurate a prepared scale, such as the one appearing with this article, and the other is to completely calibrate the individual oscillator with the aid of an accurate frequency source and a cathode-ray oscilloscope.

SUFFICIENT ACCURACY

For the general run of audio tests the prepared scales are more than sufficiently accurate. When making a frequency run, or testing a cross-over network, or checking boost and cut etc., an accuracy of better than plus or minus 5 per cent is rarely needed. It should be possible to achieve at least this order of accuracy with our prepared scale.

Almost certainly, the instrument case, prepared chassis and etched front plate will be available commercially through the usual trade channels. The front panel will have the same scale etched on to it, so that any remarks about prepared scales apply equally well here also.

The only adjustment of the frequency coverage is that provided by the 3-30 pF trimmer connected across one section of the gang. As explained last month this trimmer is designed to compensate for the stray capacitances, which will appear across the other section of the gang.

If this trimmer is adjusted correctly, your oscillator should track fairly well with the prepared scales.

To do this it is necessary to set the pointer correctly at the low frequency end of the dial and adjust the trimmer so that the high frequencies fall into proper place. This is, in a way, similar to the technique used in aligning a superhet receiver.

It should only be necessary to do this for one of the bands and the others will automatically come into line. Then the trimmer can be sealed in place with a dab of nail polish to prevent any drift due to vibration.

In order to carry out a complete, independent calibration check, another known source of audio frequencies, such as an oscillator or an audio test record, will be required, as well as a cathode-ray oscilloscope to compare frequencies. However since our oscillator has such a wide range it may be necessary to use in addition an R.F. oscillator to calibrate the high frequency bands.

Experienced users of the CRO will be familiar with the technique of frequency comparison, but many newcomers to the art may be in need of some instruction in the matter so the following paragraphs are intended as a rough guide to the procedure.

LISSAJOU FIGURES

The idea is that the output of the standard oscillator, the "known" frequency, is fed to the horizontal deflection amplifier and the output of the oscillator to be calibrated, the "unknown," is fed to the vertical deflection amplifier. Then a series of patterns known as Lissajou figures are produced, which enable us to calculate simply the unknown frequency.

These figures differ from the normal pattern produced on the CRO screen because the horizontal deflection is a sine wave and no longer the linear voltage produced by the horizontal oscillator within the CRO.

Some examples of the sort of pattern generated are shown in Figure 1, and the frequency ratios they represent are indicated below the respective patterns. These ratios are the ratios of the vertical to the horizontal frequencies.

For instance the 2:1 ratio means that the vertical frequency would be 100 c/s if the horizontal, or known, frequency was 50 c/s.

The method of counting, so as to determine the ratio, is to count the number of loops along the top edge of the trace and the number of loops along one side. The ratio of the two numbers is the required frequency ratio.

In all the patterns of Figure 1 the number of loops along the right or left sides is one.

COMPLEX PATTERNS

It is of course possible to generate more complex patterns for more complex ratios. For example, the pattern in Figure 2 represents a ratio of 5:2. Here the loops along the top of the trace number five, and those along either end number two.

A little practice with two known sources of frequency will enable the newcomer to "read" the patterns quickly.

Not only do the Lissajou patterns in-

dicate frequency ratios, but phase relationships also. Whilst this is a most useful and interesting facility and it is not our immediate concern here, we must mention it to avoid confusion.

All the oscillograms in Figure 3 represent a frequency ratio of 1:1, but in each case the phase relationship is different. The actual phase difference is indicated below each figure.

FREQUENCY DRIFT

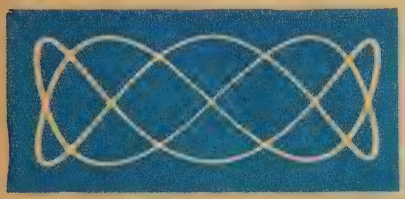
In practice the known oscillator would be set at the desired frequency and the unknown varied till one of the patterns in Figure 3 appeared. Then the two frequencies would be equal. But, as it is very difficult to set the two oscillators at exactly the same frequency, due to minute frequency variations, the pattern tends to drift between the full circle, through an ellipse and the line at 45 degrees, and back to the circle.

The actual frequency difference might be only a portion of a cycle at the low frequencies so there is no need to worry about the calibration accuracy.

As the frequencies increase it becomes more difficult to hold the pattern steady on the screen. However, any error introduced by the frequency differences is still neglible compared to normal calibration errors.

A very handy source of calibrating voltage is the mains, whose frequency is maintained, these days, very close to 50 c/s. This voltage may be used to calibrate the low frequency bands up to about 500 c/s. This is a ten-to-one frequency ratio and the resultant pattern is seen in Figure 1.

Beyond this ratio the pattern is very hard to read and another frequency, higher than the 50 c/s, is required such as another oscillator or a frequency test record.



This is an example of a more complicated frequency ratio. Counting loops along the top and one side gives a 5:2 ratio.

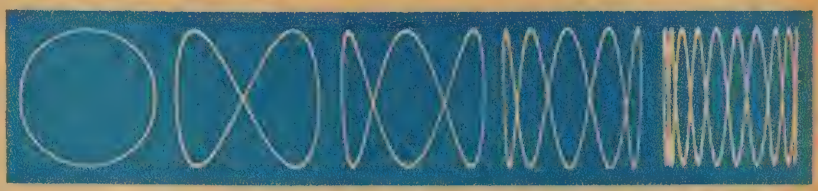
If it is desired to completely calibrate the oscillator, an attractive scale can be made up photographically. Even if you are not a photographic enthusiast yourself it is often possible to enlist the aid of a suitably equipped friend.

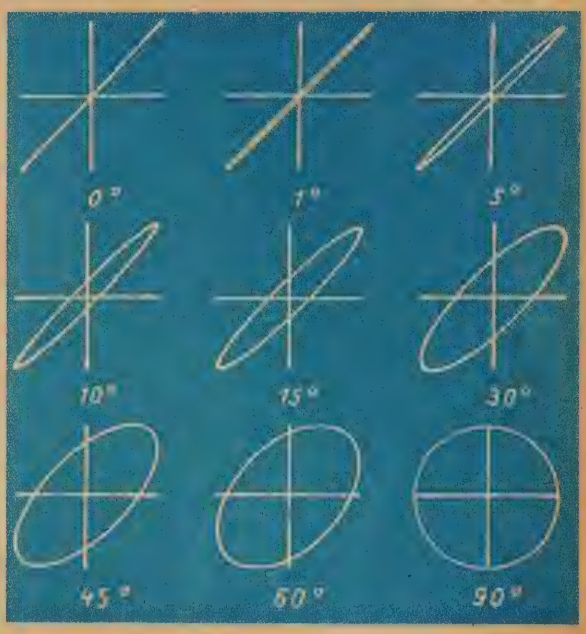
The procedure is to draw a scale about twice the size of the finished article. Use a piece of stiff white card and mark out the concentric circles, similarly to those on our scale.

Temporarily fix this to the front of the oscillator.

Prepare a one-sided cursor, by gluing a suitably shaped piece of perspex under a knob. The one-sided cursor allows easy and accurate marking of the scale with a pencil. Make the pencil markings lightly, so that they will not reproduce in a photograph.

TYPICAL FREQUENCY PATTERNS





These Lissajou figures are for the following ratios; 1:1, 2:1, 3:1, 5:1, 10:1. Beyond 10:1 the patterns are too difficult to read.

☆

These patterns all indicate a 1:1 frequency ratio. The phase relationship is different in each case. All the other patterns will drift in the same way but the effect can be ignored for purposes of calibration.

When the scale is completely calibrated mark the circles and graduations in black ink and print in carefully the letters and numbers. Photograph this scale and reduce the final print to the correct size.

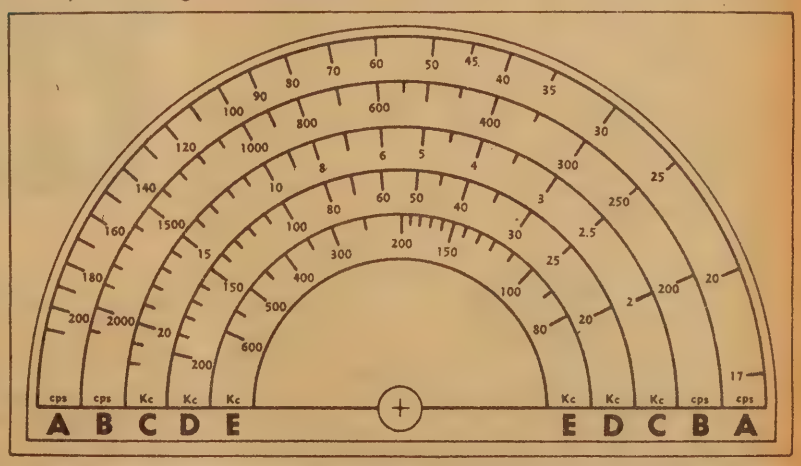
The reduction in printing helps to disguise any irregularities in the printing and makes a very neat scale.

As an alternative, letters and numbers can be cut out of magazines etc. and glued to the scale. This is somewhat tedious but often better than hand lettering.

Now, even though our oscillator is a complete instrument in itself, there may be some constructors who may wish to add to it in some way, so that it more nearly approaches the full size generator of September 1955. Let us consider some of the possibilities.

We are limited to some extent from adding too much extra circuitry by the H.T. and filament ratings of the transformer and the space available inside the case.

The transformer is a 50 mA type with a filament rating of 2.0 amps. The oscillator draws about 12 mA from the H.T., while the heater drain, including the



This is the dial scale for the oscillator. It may serve as a handy reference if you are making your own calibration, or it may be cut out and pasted on to the panel.

Like all vital components in modern electrical equipment, volume controls must be of sound original design and construction and be able to constantly maintain maximum electrical efficiency. With these basic essentials in mind, IRC have been successful in producing a miniature control with such design advantages as:—

A SMOOTH, HIGH-GRADE ELEMENT.
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pilot globe, is 1.65 amps.

Therefore, from the point of view of the heater drain, we are confined to one valve, perhaps a twin triode. Also since there is not a lot of waste space anyway, it would be difficult to accommodate the extra components for more than one valve.

It may, of course, be possible to use a larger power transformer but then the complete instrument would not fit in the present case. Such a departure would spoil the original concept of the small, uncomplicated oscillator, which we set out to build.

Therefore we are left with the option of adding a cathode follower output, or an output level indicator, or a square-wave generator, That is if we decide that any addition will be worthwhile anyhow.

LOW OUTPUT IMPEDANCE

The output impedance of the oscillator is less than 2000 ohms for all output levels. This is achieved by tapping down on the output load resistor and is quite a reasonably low impedance for the majority of amplifier input circuits.

In order to make the inclusion of a cathode follower worthwhile, therefore, we would need to aim for an impedance of only a few ohms.

The output impedance of a cathode follower depends on the Gm of the valve used and on the value of the cathode resistor. We require a high Gm and a low resistance.

Unfortunately the output voltage (which is developed across the cathode resistor) will be very low unless the plate current is high. We are somewhat limited in available current, so the cathode resistor and hence the output impedance, will be higher than we may wish.

We decided, after some inquiries along these lines, to discard the idea of a cathode follower.

In order to meter the output level over the whole frequency range it would be necessary to use a valve voltmeter because the general run of bridge rectifiers is not suitable for use at frequencies in excess of about 50 kc/s.

Also a stepped attenuator will be required for use in conjunction with the valve voltmeter. It is quite impractical to connect the voltmeter straight across the output control without the use of such an attenuator because the one meter scale would then have to read the whole range of output voltage.

EXTRA SWITCH

This would mean that outputs of the order of millivolts (which are frequently required) would hardly move the pointer off the end stop. Therefore there is a switch to accommodate, as well as the valve, meter and components.

The output of the oscillator is so level anyway, and it is so easy to set it at the level required and forget it, that we thought there was no real justification for the trouble and expense incurred in installing a meter.

On the other hand there is a case for square wave facility. The testing of amplifiers with square waves is becoming very popular. It is possible to obtain very quickly, information concerning the performance of an amplifier over a very wide range of frequencies.

"OUTBOARD" SQUARE-WAVE UNIT

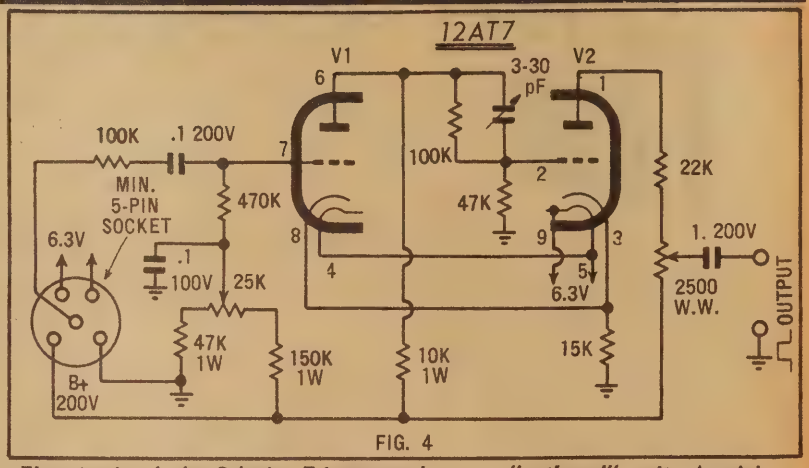
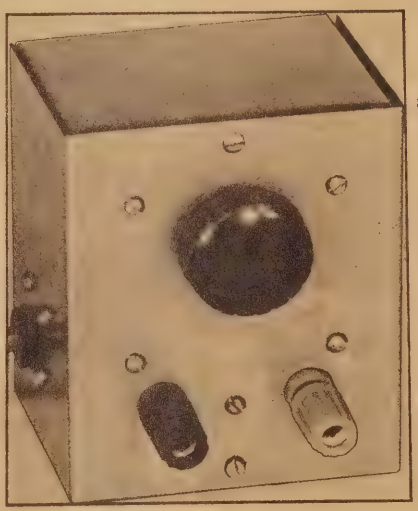


FIG. 4

The circuit of the Schmitt Trigger used as an "outboard" unit. A miniature five-pin plug is used to connect it to the main oscillator. Output is about 8 volts P-P with the 22K plate resistor for V2 shown.



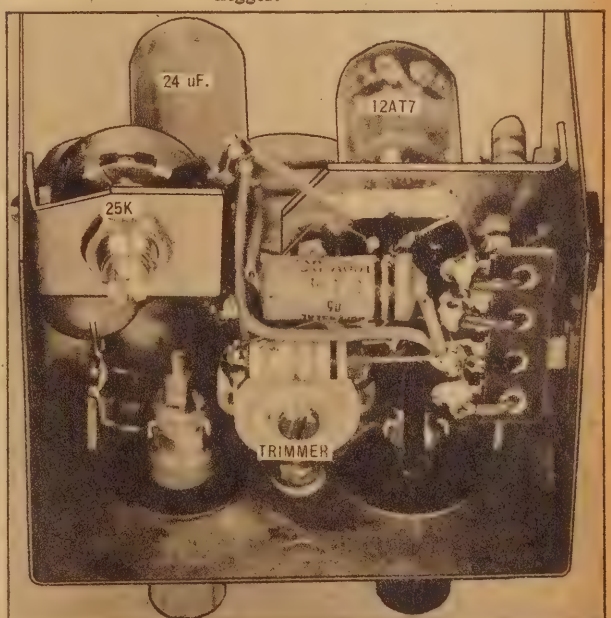
For instance, the compensation of high frequency peaks in an audio amplifier, by varying the feedback capacitance, is made very easy indeed with the aid of square waves.

This, and some other methods of square-wave testing, with some interpretation of the resultant wave forms, are discussed toward the end of the article.

Of course, as mentioned last month, it is no much use having a source of square waves if there is not also available a fairly good CRO.

The vertical amplifier response must be at least wide enough so that a 5 kc/s square wave may be displayed with a minimum of distortion and, in particular, without rounding or overshoot. The Wide Band CRO described in the February to May issues of 1957 is ideal for the purpose.

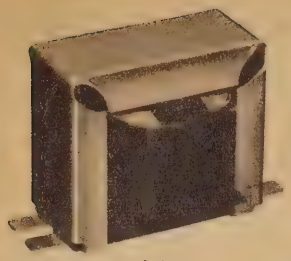
It is possible to produce square waves in a variety of ways, the simpler methods using only one valve or perhaps a twin triode. An examination of the relevant information indicated that the best circuit for our purposes was the Schmitt trigger.



The outboard unit in its case which is a standard one used for several of our previous projects. The components will just fit nicely.

☆

The inside of the outboard unit. The pot on the bracket on the left, is the 25K bias control. A screwdriver adjustment pot. could be used just as well. The bracket on the right holds the valve, and the rest of the components are supported by tag strips.



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FERGUSON offer a complete range of reasonably priced MEDIUM FIDELITY OUTPUT TRANSFORMERS ideally suited for radiograms, record players, public address amplifiers, etc., where the use of a higher priced true high-fidelity type is not justified.

TYPE No.	NOM. POWER (WATTS)	PRIMARY IMPEDANCE (OHMS)	SECONDARY IMPEDANCE (OHMS)	MTG. STYLE
OPM1	5	S.E. 7000, 5000	15, 12.5, 8, 3.7, 3.1, 2	1
OPM19	5	S.E. 7000, 5000	500, 250, 166, 125	1
OPM20	5	S.E. 10000, 8000	15, 12.5, 8, 3.7, 3.1, 2	1
OPM2	7	P.P. 10000	15, 12.5, 8, 3.7, 3.1, 2	1
OPM3	10	S.E. 4000, 2500	15, 12.5, 8, 3.7, 3.1, 2	2
OPM4	10	S.E. 4000, 2500	500, 250, 166, 125	2
OPM5	15	P.P. 5000, 3000	15, 12.5, 8, 3.7, 3.1, 2	2
OPM6	15	P.P. 5000, 3000	500, 250, 166, 125, 100	2
OPM7	15	P.P. 10000, 8000, 7000	15, 12.5, 8, 3.7, 3.1, 2	2
OPM8	15	P.P. 10000, 8000, 7000	500, 250, 166, 125, 100	2
OPM10	25	P.P. 8000, 6600	15, 12.5, 8, 3.7, 3.1, 2	2
OPM9	25	P.P. 8000, 6600	500, 250, 166, 125, 100	2
OPM14	35	P.P. 8000, 6600	15, 12.5, 8, 3.7, 3.1, 2	2
OPM11	35	P.P. 8000, 6600	500, 250, 166, 125, 100, 71	2
OPM13	55	P.P. 3500	15, 12.5, 8, 3.7, 3.1, 2	2
OPM12	55	P.P. 3500	500, 250, 125, 83, 62, 50	2
UNIVERSAL TEST SPEAKER				
OPM15	10	P.P. or S.E. 10000, 7000, 5000, 2500	3.1	2
LINE TO VOICE COIL				
OPM16	10	500	15, 12.5, 8, 3.7, 3.1, 2	1
OPM17	15	500	15, 12.5, 8, 3.7, 3.1, 2	2
OPM18	25	500	15, 12.5, 8, 3.7, 3.1, 2	2

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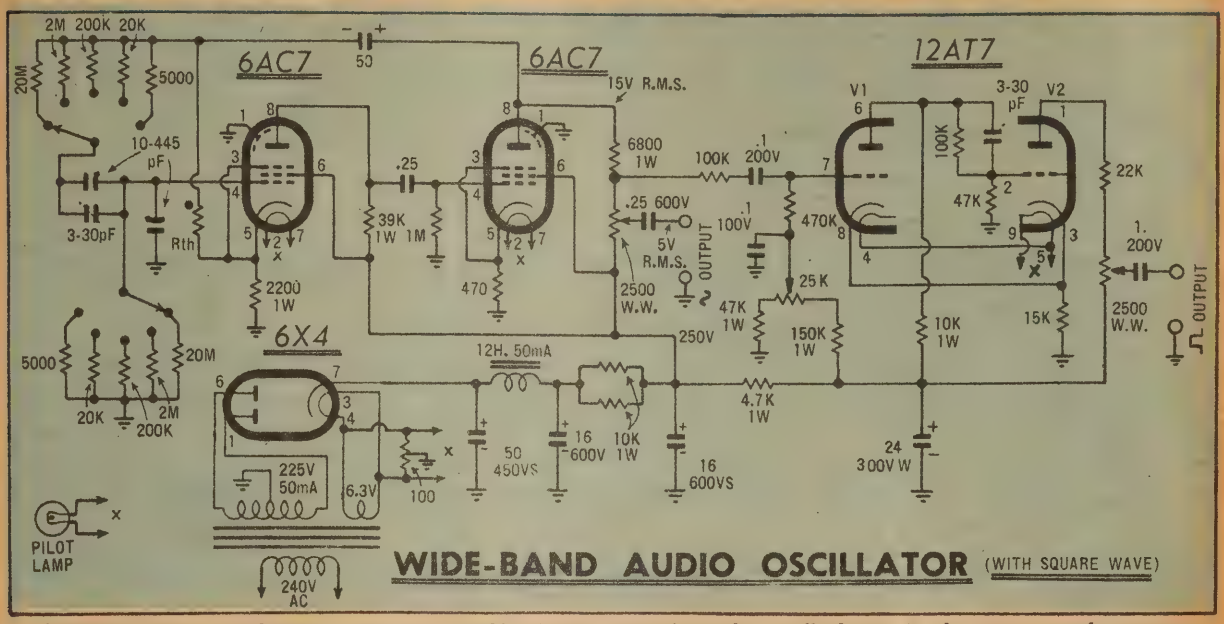
NEW OSCILLATOR WITH SQUARE-WAVE FACILITY



Oscillator section is identical with last month's circuit, apart from the small change in the power supply components.

The complete circuit of the trigger appears in Figure 4. This can serve as an "outboard unit" for use with any oscillator which does not already produce square waves, and the circuit is the same as in the complete oscillator which appears on page 37.

OUTBOARD UNIT

This "outboard unit" was designed for use with any oscillator, other than our own, in which there may not be sufficient room for the extra components. But more of that later on.

In the meantime very briefly, the trigger works in the following manner.

It is in fact, simply a switch which is turned "on" or "off" by applying a suitable voltage to the grid of V1.

In the absence of any external signal on the grid of V1, V1 is cut off by the large bias developed across the cathode resistor. This same negative voltage is applied to the grid of V2 but it is compensated for by the positive voltage developed across the 47K resistor in its grid circuit.

The 47K resistor and the 100K resistor form a voltage divider from the plate of V1 to earth.

Since V1 is cut off, the voltage on its plate is the same as B-plus. The voltage divider ratio is arranged so that when V1 is cut off there is a small negative bias on the grid of V2 just sufficient to keep its plate current at some value within its ratings. The voltage at the plate of V2 is consequently less than B-plus.

Now if a signal, increasing in a positive direction, is fed to the grid of V1 a point will be reached when V1 starts to conduct and its plate voltage starts to fall.

V2's grid consequently becomes more negative, its plate current falls and its plate voltage rises toward B-plus.

The drop in V2's plate current tends to decrease the voltage across the common cathode resistor so that V1's plate current increases and its plate voltage decreases further.

This process continues until V2 is driven to cut-off. It is a regenerative action and, in fact, occurs almost instantaneously. The result is that the voltage at the plate of V2 suddenly rises to B-plus and remains there until the signal at the grid of V1 decreases below the triggering value. When this occurs V2's plate voltage drops to its former value.

If the triggering signal at the input is a sine wave, a square wave of the same frequency is generated across V1's plate load resistor. Its amplitude will depend on the resistance of this load.

TRIGGER VOLTAGE

The grid voltage at which the circuit triggers depends upon whether the input signal is going positive or negative. That is to say, in order to switch the trigger "off" again, the grid must be driven just slightly more negative than was required to switch it "on."

Thus the circuit exhibits what is called "hysteresis." The main result of this effect is that the mark-space ratio of the square wave may not be equal and this has to be compensated for.

This is accomplished by correct adjustment of the voltage divider at the trigger input. It is formed by the 25K pot. and the two resistors on either side of it.

The sliding arm of the pot. is connected to the grid of V1 and sets the bias so that it falls mid-way between the two triggering voltages.

The variable trimmer across the 100K divider resistor is a "speed up" capacitor, which improves the switching time so that the square wave at the plate of V2 has a small rise time.

However, increasing the value of this trimmer beyond a certain point causes overshoot, which appears as a peak on the waveform.

Figures 5 to 10 show some of the square waves obtained from this unit.

When the trigger is wired, turn the oscillator on, set the frequency to about 4 or 5 Kc/s and connect the square wave output to a CRO. Turn the 25K pot. until a square wave appears and adjust it till the mark space ratio is equal. That is the distances T1 and T2 in Figure 7.

Now adjust the trimmer capacitor for maximum capacitance so that the spikes of Figure 5 are present. Now reduce the capacitance till the spikes have just disappeared.

The square wave should now appear as in Figure 6.

When we started work on the oscillator we could not foresee that the square wave adaption would work out so well. More intent on producing a sine wave output only, we were not worried about filling the available space in the power suply section with tubular capacitors.

However, we subsequently found that it was necessary to use chassis mounting electrolytics in order to be able to fit the trigger into the case.

DIFFERENT MOUNTING

This in no way affects the working of the oscillator as a separate instrument, and the chassis blueprints will be prepared with mounting holes for these capacitors rather than for the tubulars.

These capacitors are seen in the above chassis view on page 39.

Since the output level of both sine and square wave generators must be controlled, it would normally be necessary to use two pots or a switch to change over from one output to the other. Because either of these approaches would necessitate an extra hole being punched in the front panel, we have decided to use a dual pot.

The only change required on the front

GENERAL ACCESSORIES

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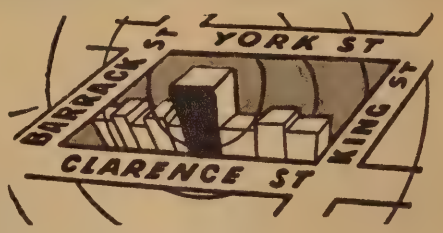

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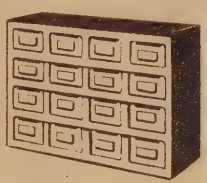

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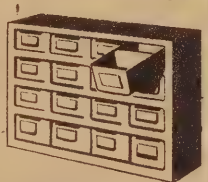
As Model A—but fitted with Divisions.



MODEL D
52/-
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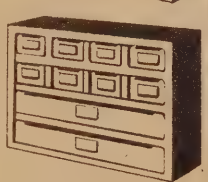

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Single Gang Condensers, **1 guinea**
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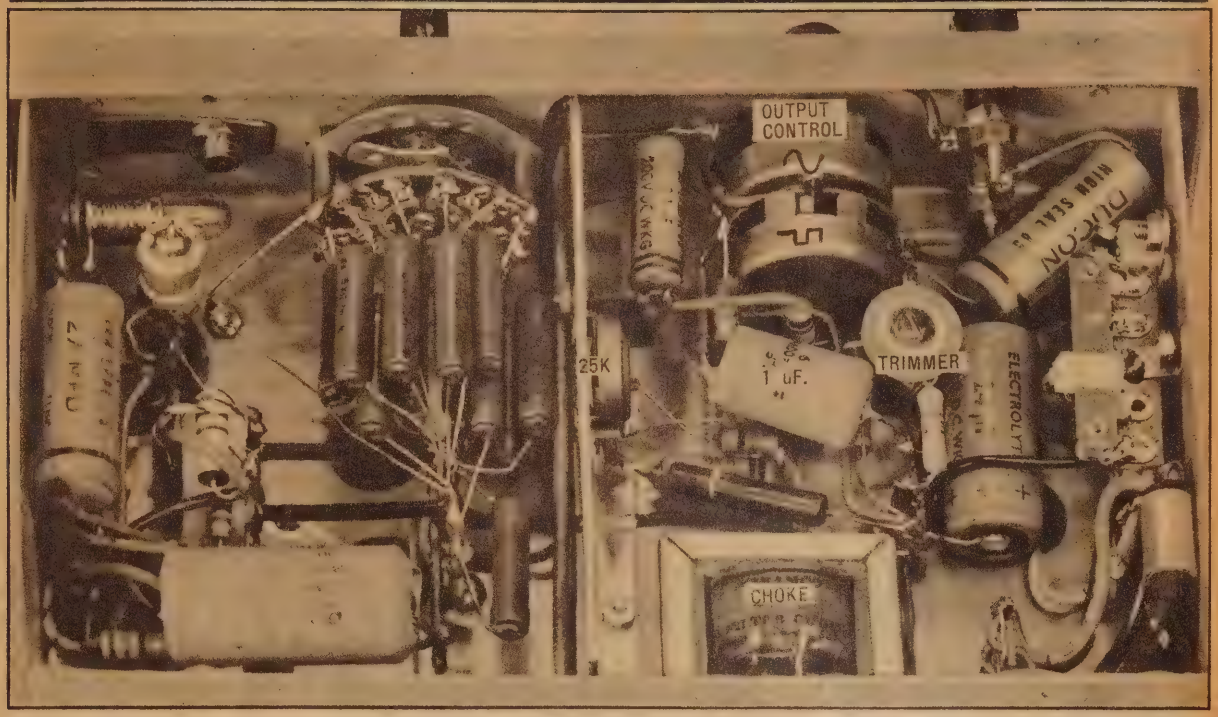
UNDERNEATH VIEW SHOWS THE WIRING DETAILS



The components to the left of the centre screen are unchanged. All the trigger components fit into the right hand side. The 25K screwdriver pot. is mounted on the screen and the trimmer on a tag strip.

panel will be the addition of an extra terminal above the two already on the right hand side.

The etched panel will be supplied with the two bottom holes punched and the position of the third, for square wave output, will be indicated by a circle and the square wave symbol.

This means that either version of the oscillator may be built, using the same basic metal work kit.

The sine wave input for the trigger is taken from the "top" of the sine wave output pot, and provides just about the right level of drive.

POWER SUPPLY IMPEDANCE

A small amount of distortion of the square wave occurs at the low frequencies because of interaction with the oscillator in the common power supply impedance. This is corrected by decoupling the trigger supply with the 4.7K resistor and the 24 uF. capacitor.

The 100K resistor in series with the sine wave input prevents interaction between the trigger and the oscillator. Without it in circuit, there is a small "pip" on the sides of the sine wave as the trigger switches off and on.

When the sine wave output is fed into a low impedance, only the output voltage drops and there is no distortion of the wave shape. However if the square wave output is fed into a low impedance, at very low frequencies, some distortion is introduced with the 1.0 uF. coupling capacitor shown.

If it is intended that the square wave output is to be fed into low impedance circuits the coupling capacitor will have to be increased in value. This is best decided by trial and error. At the moment there is negligible distortion when the output is fed into 300K at 25 cps.

To save on bulk, an electrolytic capacitor may be used in the output circuit. However, there will inevitably be some leakage in this type of capacitor and a resistor of about 25K should then be connected across the output terminals to minimise the effects of DC on the inputs of the amplifiers under test.

For most purposes the 1.0 uF. will be more than sufficient.

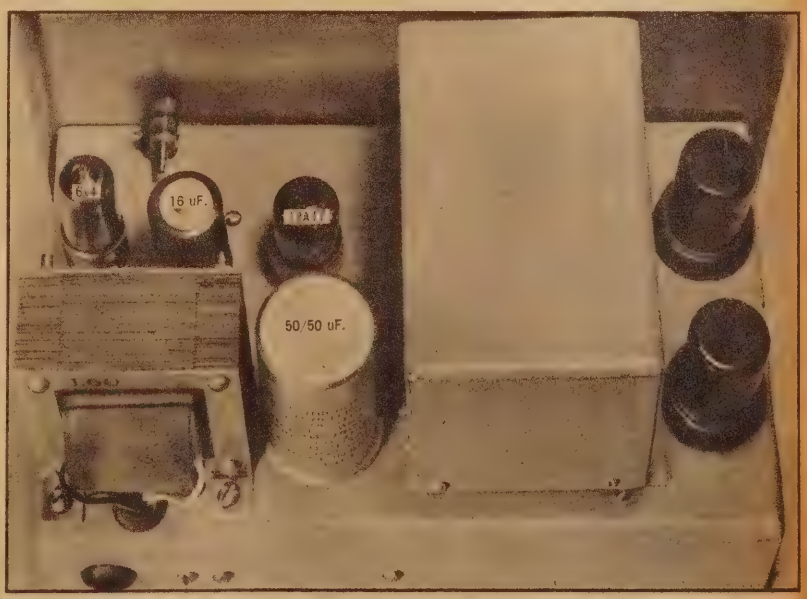
The 25K pot. is mounted on the screen, and can be seen in the under-chassis view. A standard pot. may be used here but the screwdriver pot. is cheaper.

One eight-tag strip is all that is needed for most of the components. It is seen to the left of the 24 uF. electrolytic in the under-chassis view. One small one-tag strip is also required next to the 25K pot.

There is not overmuch space, so a little care is required in arranging the components. Wire the valve socket first with the components that connect directly to it. The socket is oriented so that pin number 1 is nearest to the 25K pot.

There undoubtedly will be many an oscillator in use, either commercial or home built, which could be made all the

(Continued on page 42)



The only change above the chassis is the two extra chassis-mounted electrolytics and the twin triode. The layout becomes rather compact but is not too difficult.

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THE COMPLETE UNIT IS SUPPLIED IN ATTRACTIVE AND DURABLE TWO-TONE COVERED CASE COMPLETE WITH ACOS MICROPHONE AND FITTED WITH DUAL ROLA SPEAKERS.

The amplifier incorporates the latest "Mullard" tape recorder circuit equalised to C.C.R. standards giving perfect reproduction from recorded tapes. Outlet to power amplifier. Extension speaker outlet and "magic eye" level indicator. Amplifier is completely shielded and fitted with perspex dress plate to match deck. Output: 4 watts can be used as straight amplifier if required.

Model TR2 incorporates the new Collaro "Studio" Deck which features:–

- **High Fidelity. Frequency response 40 to 12,000 cycles at 7½in per second.**
- **Three 4-pole shielded motors.**
- **Three speeds, 1-7/8, 3¾ and 7½.**
- **Fast forward and rewind, 1200 ft in 65 seconds.**
- **Two track.**
- **Light piano key controls.**
- **PAUSE CONTROL**
  This has the effect of stopping the transit of the tape past the "Record/Playback" and "Erase" heads and applying the brakes to the spools while leaving all switches and mechanical functions in their selected positions. Typical application is to pause whilst recording to omit speech interposed between musical selections. Control will only work whilst it is held in position.
- **TAPE MEASURE AND CALIBRATING DEVICE**
  The three digit counter makes the location of any recorded passage the simplest of operations.
- **TRANSCRIPTION TECHNIQUE**
  A large diameter flywheel with ground and lapped steel shaft running on a ball at the bottom of long bearing reduces friction and virtually eliminates "wow" and flutter at less than 0.15 per cent at 7½in per second.

COMPLETE RECORDER WITH MIKE 69 GNS. f.o.r.

A NEW POPULAR PRICED RECORDER AT 49 gns. f.o.r.

MODEL TR3. For this recorder we have chosen the new English B.S.R. deck. This is a two track single speed unit (3¾in per second) giving two hours' playing on a 5¾in long play tape or one hour on a standard 5in tape.

Automatic locking device prevents accidental erasure. Frequency response 60 to 8,000 cycles.

The five valve amplifier including "magic eye" level indicator has two inputs, for microphone, radio, or pick-up; and outputs for external amplifier or speaker, equalised to C.C.R. standards. Can be used as straight amplifier if required. Output 3 watts.

The recorder is fitted in attractive two-tone case with dual speakers and microphone.

Overall dimensions 14in x 10in x 6½in. Weight 26lb.

CLEARANCE OF HI-FI MONAURAL EQUIPMENT

10 VALVE DUAL WAVE HIGH FIDELITY RADIOGRAM CHASSIS WITH R.F. STAGE. INCORPORATING THE MULLARD 5-10 AMPLIFIER AND TONE CONTROL CIRCUIT (SEPARATE BASS & TREBLE CONTROLS) AND SUPPLIED WITH THE NEW ROLA 12PX SPEAKER. **£38/10- F.O.R.**

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CLASSIC RADIO TAKE PRIDE IN ANNOUNCING COMPLETE NEW RANGE OF STEREOPHONIC EQUIPMENT

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Complete tuner and amplifier for stereo, comprising a compact Hi-Fi Stereogram in two units featuring a high gain dual wave tuner with tuned R.F. stage, multi-input two channel pre-amplifier with tone controls in one unit and two Mullard 5-10 amplifiers with push-pull outputs and power supply on second chassis. **£69/15/-** F.O.R.

Two pair of M.S.P. Jensen speakers or two Rola 12in dual coned speakers supplied. Power output 10 watts per channel (20 watts). Frequency response of amplifier 40 to 15,000 cycles.

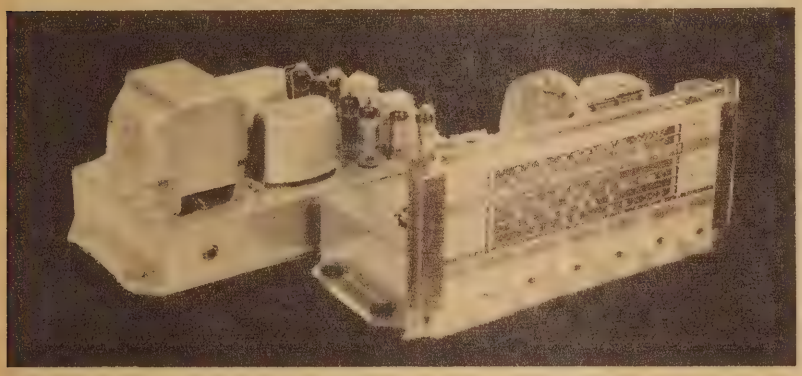
THIS UNIT CAN NOW BE SUPPLIED WITH THE NEW ROLA 12 PX SPEAKERS

10 VALVE HI-FI STEREOGRAM CHASSIS

Complete stereo unit comprising dual wave tuner with tuned R.F. stage, multi-input two channel pre-amplifier with tone controls and two Mullard 3-3 amplifiers, power supply on separate chassis. Supplied with two Rola 8MX speakers. Power output 4 watts per channel. Frequency response of amplifier 40 to 15,000 cycles. **£49/15/-** F.O.R.

8 VALVE HI-FI STEREOGRAM CHASSIS

Complete tuner and amplifier for stereo incorporating the "Mullard 2-2" amplifier circuit with separate bass and treble controls. Output 3 watts per channel. Supplied with two Rola 8MX speakers. Frequency response 50 to 10,000 cycles. **£41/15/-** F.O.R.



ALL UNITS INCORPORATE THE NOW FAMOUS "MULLARD" AMPLIFIER & TONE CONTROL CIRCUITS.

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SPECIFICATIONS OF OUR NEW HI-FI CHASSIS

NEW:

Ultramodern circuit using high gain valves including "magic eye" tuning indicator. Permatuned iron cored coils and intermediates giving excellent interstate reception and a short-wave range of 12,000 miles. All valves used are the new Mullard nine-pin Innoval series.

NEW:

Tone control and audio stages incorporating the Mullard 5/10 amplifier circuit with separate bass and treble controls giving plus or minus 15 db boost or cut at 50 cycles L.F. and 10,000 H.F., combined with push-pull output with inverse feed-back gives you really high fidelity reproduction from your radio or favourite recordings.

NEW:

Dual speaker combination using the new Jensen M.S.P. 12PR woofer with matched tweeter and cross-over network giving a frequency response of 40 to 12,000 cycles. If required the Rola 12MX speakers can be supplied (with the 8 valve stereo chassis, two Rola 8MX speakers are supplied). A.W.A. output transformers used on all units.

NEW:

Six position selector switch is incorporated in all chassis with compensation for L.P. recordings and provision for stereo F.M., or TV tuners and tape recorder.

NEW:

Large calibrated edge-lit dial in perspex (11in x 6in) with main stations of each State in prominent type. Dial fitted with counterweight drive, giving smooth tuning. Dial can be supplied in cream or black with matching knobs and escutcheon to suit contemporary blond or walnut finished cabinets.

NEW:

Sensitive "magic eye" tuning indicator (EM80) making tuning simple and positive even on interstate, overseas and country stations.
All chassis are wired for the fitting of F.M. tuner or tape recorder, special plug being provided on back of chassis, also pick-up terminals and outlet for gramo. motor.
Power switch is fitted to volume control. Audio end of set can be used with TV receiver if required.

COMPLETE RANGE OF DUAL, COLLARO, B.S.R. AND GARRARD, STEREO PLAYING EQUIPMENT IN STOCK

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MONTHLY NEWSLETTER

Dear Readers,

This month I would like to round off our world review by mentioning some of the American equipment such as Fisher amplifiers and tuners, Rek-O-Kut turntables and Grado pickups, which are already available in our showrooms. This is something long awaited by many who have been seeking the best in the American gear and we can really say that they have been well worth waiting for. Although designed and priced to suit the serious stereo enthusiast, we feel that the technical specifications will be of considerable interest to all our readers.

In the range of Fisher amplifiers there are four models from which to choose, with a total of 12 variations, and when referring to power output in watts I am talking in the British power range and not the American. Model X100 stereo is a 15W per channel, self-contained tabletop amplifier for cabinet mounting or in its own leather-covered metal case; 17 front panel controls and switches and, as the manufacturer claims, which we verify, hum, noise and distortion completely eliminated. It is fitted with electronic crossover for a phantom third channel and a switch to convert volume control to a loudness control.

The next model is the X202 stereo with 25W per channel, 16 stereo inputs, a stereo dimensional control for fusing the signals from both channels so as to balance the machine for room acoustics, phantom channel volume control, speaker damping factor control, rumble and scratch filters and completely remote controlled from your chair without connecting leads. The Fisher FA100 stereo model with 50W per channel is an alternative version of this and model 300 is a 60W version.

The Fisher 800 is a 40W per channel model with a stereo FM-AM tuner self-contained and a mixer multiplex system for simultaneous side bands stereo broadcasting. In this unit the valve heaters are supplied with DC silicon diode power supply and two completely separate power supplies, one for each channel. The latest American milar and silicon capacitors are used throughout all Fisher amplifiers and they are all built to the same outstanding quality, price regardless, and all FM tuners cover the TV bands.

The fourth model comprises separate units — a 20W per channel amplifier and a remote control head type 400CA, including FM-AM multiplex stereo tuner. FM sensitivity is less than one microvolt with four IF stages, background noise .1 p.c. of full modulation; the AM tuner incorporating a temperature compensated converter stage; the tuner section of the control head employing 20 valves and four diodes, 16 stereo inputs and 11 audio controls with built-in bass and treble crossover networks, using seven valves and a separate silicon power supply. We also have a sample range of Fisher pre-amplifiers and monaural-stereo conversion units.

The minimum specifications of all Fisher units are a frequency response 5-36,000 CPS; input sensitivity 1.5 mv. per channel at 5,000 ohms load; treble and bass tone compensation plus or minus 15 DB switched in the three steps by master control and variable by minor control; complete channel separation or mixing to taste infinitely variable for phantom third channel and distortion less than an average of .05 p.c.

In the Rek-O-Kut range of turntables there are again four models available, either factory built or in simple self-assembly kits. We might emphasise that these turntables are not for the amateur. Full details will be supplied on request.

A token stock of the famous Grado pickup arms and cartridges is also available and I will repeat the laboratory specifications without comment other than adding that we have proved them correct apart from the last point.

Frequency response 10-35,000 cycles per second channel; inter-channel output balance plus or minus .5DB; inter-channel frequency balance plus or minus .5DB; output 5MV per channel at 10CMV; DC response 600 ohms per channel impedance 600 ohms per channel tracking force; two grams, stylus mass .8 milligrammes, input load above 5,000 ohms channel separation in excess of 25DB, radium active element half life 1,600 years. These units are, of course, employing moving coil type generator.

The Grado arms are statically balanced and inert tracking force being exerted by a sliding column of mercury. The arms themselves are made of specially selected timber and are completely non-resonant, pivoting, if achieved, by a single jewel pivot point pressure sealed and all metal fittings are made of magnesium alloy to reduce dynamic weight.

Trade enquiries are welcomed on all of the above equipment and on Fisher and Rek-O-Kut equipment for which we are the sole Australian distributors. Audac, Jensen and Lansing speakers and Scott, Harmen Cardon and Bell amplifiers are also available.

In conclusion, readers who belong to the floor-walking brigade will be interested to know that the yelling power of a new baby is three watts plus or minus 5DB at 3 a.m. It is interesting to speculate whether the parents of twins would ever again be stereo enthusiasts.

Yours,

UNITED ELECTRONICS (A/ASIA) PTY. LTD.

(Victorian Tele-Service Pty. Ltd.)

Phone: 211-4501

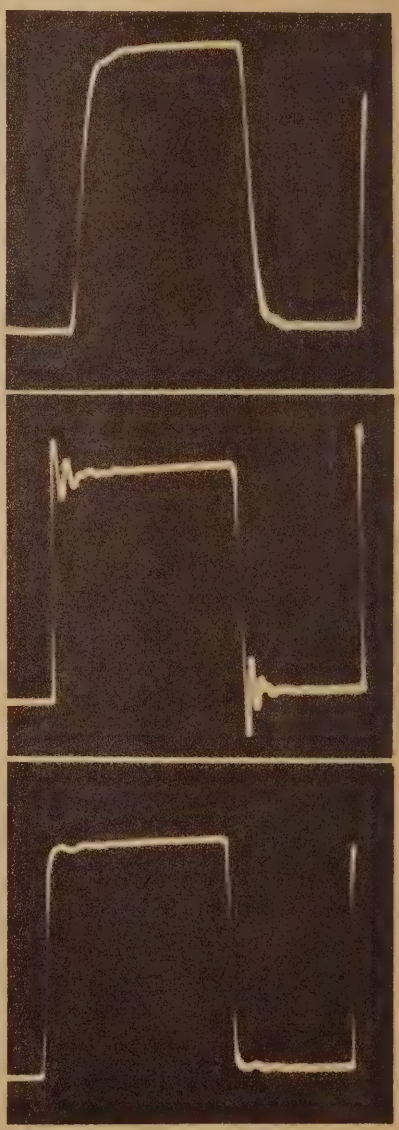
more useful by the addition of this trigger and, if there is no room inside the case, the "outboard unit" may be used with almost equal convenience.

The construction of this unit is shown in the two photographs on page 35. All that is required from the main oscillator is 6.3 volts for the heater and about 200 volts at 5 mA. of H.T. The R.M.S. voltage required to drive it is about 1.0 volt minimum.

We have suggested a miniature five-pin plug and socket to connect the trigger to the oscillator, but any other arrangement will do. The layout is not critical.

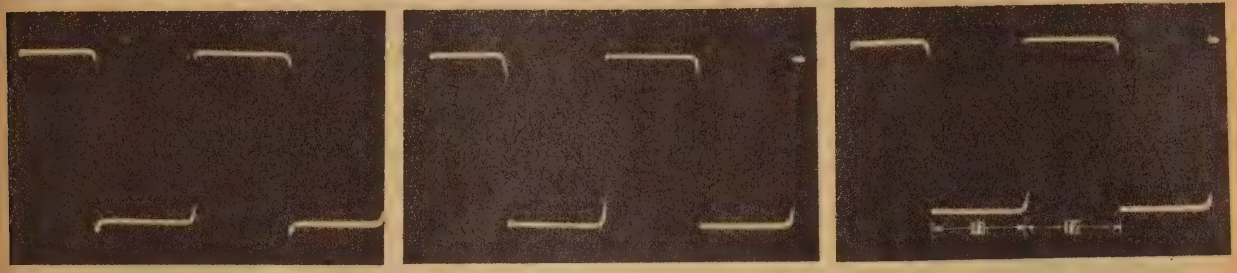
The metal box in which it is housed is a standard box originally used by us for the dummy loudspeaker loads and measures 3¼in wide, 4in high, and 2¾in deep. It is marketed by Messrs Watkin-Wynne, Crow's Nest, Sydney.

Figures 11, 12 and 13 are some oscillograms of some square waves from an amplifier we were testing recently in our workshop. They are an ideal illustration of the use of square waves in testing of this nature.

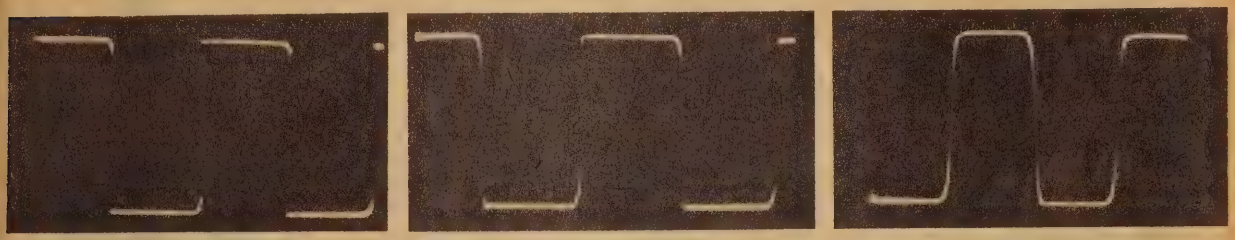


Figs. 11, 12 and 13. Fig. 11, top, is amplifier without feedback. Fig. 12, left, is same amplifier with 20 db of feedback. Fig. 13 same amplifier after phase correction.

TYPICAL WAVEFORMS FROM NEW OSCILLATOR



Figures 5, 6 and 7. Fig. 5 is 5 kc/s with some overshoot. Fig. 6 is same wave with trimmer adjusted for correct shape. Fig. 7 is a 1 kc/s wave.



Figures 8, 9 and 10. Fig. 8 is a 200 c/s wave. Fig. 9 is a 10 kc/s wave. Fig. 10 is 50 kc/s and is still definitely a usable wave.

Figure 14 is a set of curves of the amplifier response with one curve for each of the square waves shown. Curve 1 is for Figure 11 and so on.

Figure 11 is a 5kc. wave and the amplifier is without feedback at all.

The plotted curve of the response to high frequencies shows that the output falls rapidly after about 10 kc. This is also indicated by the rounded corner on the leading edge of the square wave.

Then 20 db of feedback was added from the voice coil to the input of the amplifier.

The resultant square wave of figure 12 contains some interesting information. The leading edge is more nearly vertical; that is, the rise-time is much less, indicating that the response of the amplifier has been extended.

DAMPED OSCILLATIONS

There is a large overshoot and ringing indicated by the damped oscillations on the top and bottom corners. This means that there are peaks in the response at very high frequencies caused by phase reversals in the amplifier. It is possible that the amplifier will break into easy oscillation if left in this condition.

It will be seen that there is one large damped oscillation and one or two others which are almost swamped by it. By measurement it is obvious that the frequency of this main oscillation is about 20 times that of the square wave. That is about 100 kc.

The other peaks causing the minor disturbances on the main oscillation are much lower in amplitude and it is difficult to pick the frequencies at which they occur.

The plotted curves show a main peak at about 120 c/s and two others at 200 and 75Kc respectively. The main peak is considerably higher than the others.

The peaks are caused in the first place because, at the high frequencies, phase changes occur through the amplifier, such that the feedback can become positive.

This effect can be compensated to some extent by adding a small capacitor across the feedback resistor.

Various capacitors were tried until the square wave of Figure 13 was produced. The main oscillation has been completely cancelled leaving only the minor ripples.

This small ringing is small price to pay for the greatly improved frequency response, which plotted curves show to extend to almost 100 kc. There is still a small step at about 80 kc but it is not too serious.

It is possible to introduce a step circuit at the plate of the first valve to push this step down a little further so that it will not cause instability. Curve 4 is the result of doing this.

The step circuit is in the form of a resistor and capacitor in series from the plate to earth. The capacitance is selected to give maximum stability when the amplifier is loaded capacitatively.

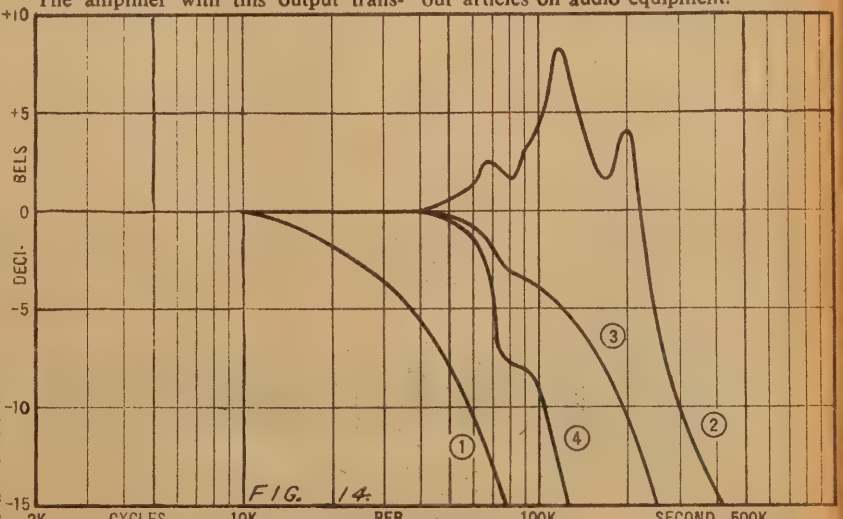
The amplifier with this output transformer would not be considered really first class and the final result is really only a compromise. However it would still sound better than average.

A better quality transformer would exhibit, if any, only one resonant peak and that at a much higher frequency. It is therefore much easier to compensate for it and finish with a really smooth roll off.

Now the point of all this is that it seems quite laborious to plot the curves when the square wave indicates immediately all the necessary information.

It is not necessary, for instance, to know the exact frequency of resonant peaks, as long as we can see clearly whether they have been effectively cancelled or not.

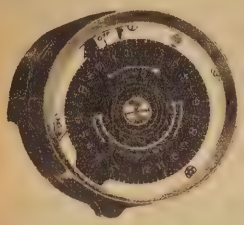
There are many other uses for the square wave, which we cannot discuss here, because of space limitations, but the topic is occasionally mentioned in our articles on audio equipment.



Curves of the amplifier, with and without feed back, and with the capacitor across the feed back resistor. Curve 4. is the result of adding a step circuit at the plate of the first valve in the amplifier.

THE WARBURTON FRANKI PAGE No. 1

SANGAMO SSA/0 TIME SWITCH



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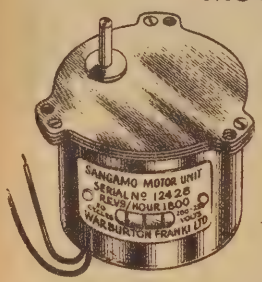

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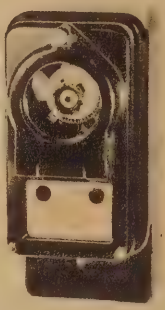

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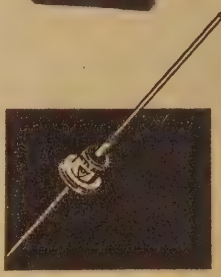

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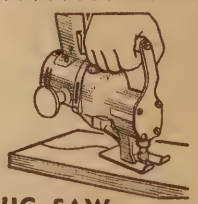

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FROM THE SERVICEMAN WHO TELLS

Have you ever wondered just what precautions are taken by the average receiver or components manufacturer to ensure that the finished product is free from defects? It's a fair question, because, particularly in TV, there is quite a lot of money involved and the customer has a right to feel that his interests are being reasonably protected.

I DON'T know how many of my readers have seen the inside of a radio factory, but I imagine that a fair percentage would work in such places, while others, like myself, gained much of their early training in such an environment.

These people would doubtless agree that most manufacturers go to considerable lengths to see that nothing defective reaches the customer. In fact, nothing defective should ever even come into being—at least, in theory—because the process worker isn't supposed to make mistakes in the first place.

INSPECTION SYSTEM

But, of course, mistakes do occur, so there is always an elaborate inspection system set up to weed these out. Particularly in the case of complete receivers, or expensive and complicated components or sub-assemblies, there will be at least two, but usually more, inspection processes through which they must pass before receiving a final O.K.

While each inspector may be given a specific group of tests to make, he is expected to be on the lookout for anything at all which may be below standard or even questionable. The reasoning is obvious; the more people that handle the device, the less chance there will be of a mistake being overlooked. Considering all these precautions, from the production line right through to the packing department, the chances of a fault slipping through should be virtually nil.

Or at least, that is what one would imagine. But, as you have probably guessed, all this is leading up to a story which proves that the impossible can happen.

On a recent Saturday morning, a customer rang me with a tale of woe about his TV set. It had "packed up" the night before, thereby depriving him of his favourite variety show, and he was now anxious to know whether I could get it going again in time for the afternoon sporting service. (As can probably be imagined, no one likes to be without their TV set over the weekend.)

NO PICTURE

In answer to my preliminary questions, he was able to tell me that the picture had failed completely, but that the sound appeared to be normal. This seemed straightforward enough and I said I thought he should have his set working in time for the afternoon program.

When I arrived at his house and switched the set on, it behaved exactly as he had described it. There was plenty of sound, but no sign of a picture, or even a raster. Excluding the picture tube itself, I visualised an EHT failure—with all the possible variations of this theme throughout the line oscillator and output stage—or a failure of picture tube grid or cathode voltages in such a way as to cut off the electron beam.

While musing thus, I was removing the back of the cabinet and hoping that it would turn out to be something obvious, such as a faulty valve heater. As I eased the back free of the cabinet it slipped in my hand and landed on the lounge-room carpet with the mildest of bumps. Almost immediately I became aware of light from the face of the tube reflected inside the cabinet, while the owner, looking at the front of the set, remarked, "Well, it didn't take you long to fix that."

In a sense he was right, because there was now a normal raster on the screen and a snowy image that was being picked up on the aerial terminals alone, the aerial having been removed to allow the back to be taken off. Replacing the aerial temporarily restored the picture to normal.

EASIER TO FIND

Unfortunately, I had to disillusion him and admit that I had done nothing as yet except remove the back, and that it was the slight bump when this landed on the floor that had effected a temporary cure. To myself, I expressed the hope that it would stay as touchy as it was at the moment. That way, it shouldn't be particularly hard to find.

But the thing had turned perverse. Thinking in terms of an EHT failure, I went all over the appropriate section of the chassis, tapping gently at both it and the valves, but without result. Then I spread out and went right over the chassis, at the same time becoming rather more vigorous. Still there was no response and the first effort looked like a fluke.

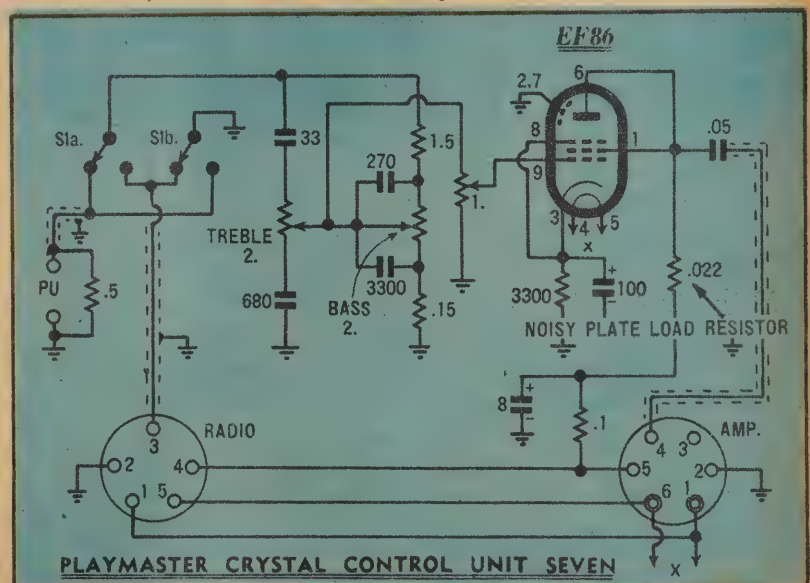
I found the trouble quite by accident. I was reaching well into the cabinet to tap a likely valve when my arm brushed against the EHT lead. Apparently it wasn't as well insulated as it might have been, because the thing bit me. It wasn't a serious bite, but I'm afraid my reflexes work without waiting to worry about the severity of such things and I pulled my arm out pretty smartly.

LOOSE BASE

As I did so, it touched the cable from the chassis to the picture tube base, jerking it slightly. Immediately, the picture vanished again and I quickly established that it could be made to come and go at will, depending on the angle or tension of the cable.

Closer examination showed that the base of the picture tube was very loose and that it was the movement of this portion, rather than the socket, which affected the picture. It seemed almost certain that there was a faulty pin connection inside the base, though whether it was a result of this being loose was hard to say.

For the moment, I was more concerned with the problem of getting the socket off the base without causing any more damage. The base was very loose, in fact suspiciously so, and I gained the impression that it would be very easy



Noise in the control unit was eventually traced to a faulty plate load resistor. Shorting the grid (pin 9) to chassis, by turning the volume control down, automatically eliminated all components in the frequency compensating network ahead of this point

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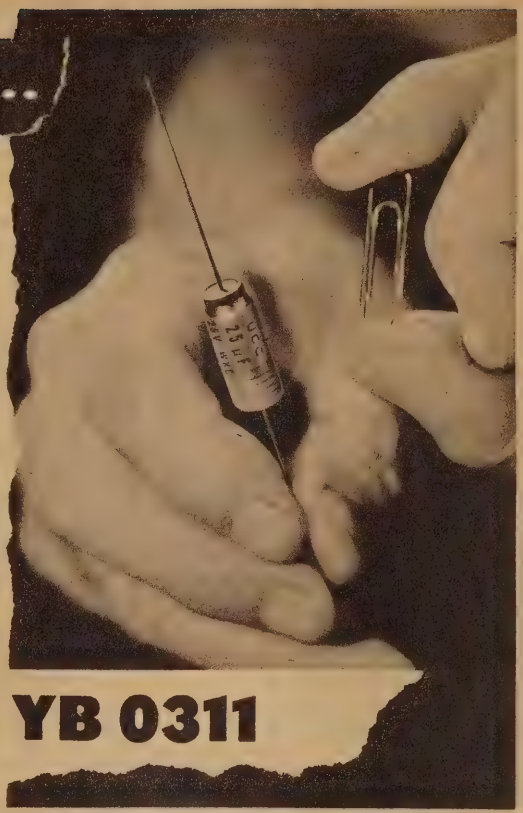

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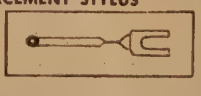

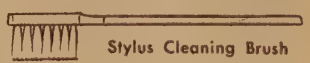

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to break another wire inside it if it was unduly twisted or strained.

I finally coaxed the two apart by holding the base firmly in one hand and rocking the socket gently from side to side while easing it away from the base. It took a few extra moments, but I felt the care was justified.

With the socket off, I took a closer look at the base. I would not have been surprised to find a dry joint in one of the pins, or even a pin not soldered at all, as I have struck both situations in ordinary valves. Again, it was quite possible that one of the leads had broken off inside a pin, due to possible twisting of the loose base.

But I wasn't prepared for what I found. Of the six active pins on the base, only one had ever been soldered. The remaining five were as bare as a new-born babe and it was obvious that no solder had ever touched them.

"IMPOSSIBLE" SITUATION

And that, of course, is just the kind of "impossible" situation which I spoke of at the beginning of this article. I imagine one would have a hard time convincing the makers that such a fault actually had occurred unless, like me, they had the evidence plainly before their eyes.

But what about all the fancy inspection systems so carefully worked out to detect just such errors? How could a device like a picture tube pass through all the electrical, mechanical and visual inspections which are normally provided, without someone spotting a fault as blatant as this one?

Even more puzzling, how did it continue to operate satisfactorily throughout the process of being fitted to a set, tested, delivered to the dealer, then to the customer's home, and for nearly a year thereafter?

The only point which I imagine helped in this improbable sequence was the fact that the base almost certainly was securely cemented at first and that the lead wires happened to be favourably placed in the pins. When the base cement failed—for whatever reason this stuff does fail—the base was free to wobble about and upset the lead wire/pin relationship. And that's where I came in.

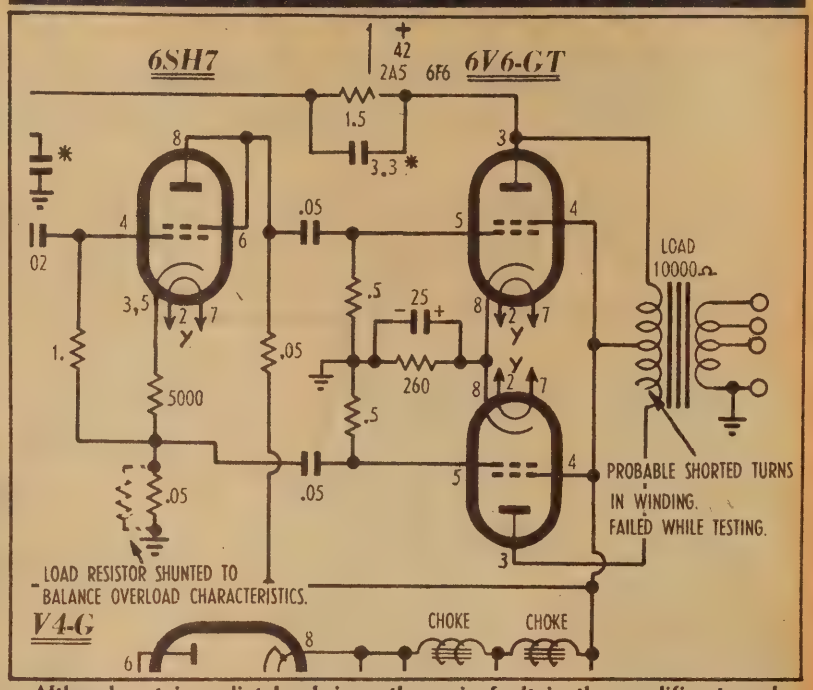
WHAT TO DO?

Of more immediate importance was what to do about it. Since each wire was clearly visible where it had been clipped off preparatory to soldering, I felt there should be no problem in doing the job myself. In many ways, this seemed to be the best idea, but I did wonder whether the tube should be sent back to the makers.

Not that I hoped to gain any financial advantage for the customer, since it might prove more costly than it was worth. No, it was just plain cussedness. I would have dearly liked to be present when the tube arrived on the factory manager's table and to follow the inevitable reaction as it was passed down the line. And even if I couldn't actually be present, the mere thought of it would provide some satisfaction.

Unfortunately, it wasn't as easy as all that. The customer wanted his set as soon as possible and it would be hard to justify depriving him of it, quite unnecessarily, simply to back up a complaint to the tube manufacturer. Of course, I could loan him a tube while

TROUBLE IN THE OUTPUT STAGE



Although not immediately obvious, the main fault in the amplifier turned out to be a faulty output transformer. Earlier, lack of balance was temporarily corrected by shunting the .05M cathode load resistor.

the post-mortem was going on, but who would pay for the time required to remove his tube, fit another one, then reverse the procedure when his tube was returned?

I could hardly ask the customer to foot the bill, and I didn't feel like carrying it myself, particularly as it was not strictly necessary. I decided my first idea was the best one, after all.

Armed with some fine emery cloth, a good paste flux and a hot soldering iron, I tackled each pin in turn, spending a fair amount of time on each to make sure that the solder really "took." When it was finished, I had no doubt there would be no trouble from that source.

As a final measure, I bound the base as securely as possible to the neck of the tube with good quality tape. While not a perfect repair, I felt it would last as long as the tube if not grossly abused. And so I left the customer to enjoy his afternoon sport—from the comfort of his armchair.

As a break from TV, my next story concerns a radiogram. It was not a conventional commercial radiogram, being a combination of various R., TV and H. units, nor a conventional customer, being one of my own in-laws.

REMOTE CONTROL

Just to make it harder, said in-law lives in a distant suburb, meaning that my early introduction to the problem was very much by remote control. (I now have some idea of what the R., TV and H. boys go through, trying to diagnose faults by letter—some of them not always as precise in their descriptions as one would like.)

The complete set-up consisted of three units; tuner, control unit, and main amplifier, all based on designs published in R. TV and H. in recent years. The tuner was essentially the Baby Tuner of May, 1956, the control unit the No. 7 version for crystal pickups (November, 1955) and the amplifier the Basic Amplifier of April, 1956.

I was familiar enough with the combination, having advised him about it when he expressed a desire for something rather better than the ordinary run-of-the-mill commercial units, but which wouldn't leave a whacking great mortgage over his head. Having been thus advised by yours truly, he had had the units built up by a mutual friend.

IMPRESSIVE OUTFIT

The final result was quite impressive and, when housed in an attractive cabinet, took pride of place in the family lounge-room. In conjunction with a speaker enclosure built into a disused fireplace it provided a standard of musical entertainment comparable with many more expensive set-ups and certainly better than that from the average commercial unit. All in all, he was very happy with the whole thing.

However, after several years of faithful service, minor troubles began to occur. The first one concerned the radio performance, the sensitivity having dropped noticeably. However, since it was still adequate for normal local listening he did no more about it than mention it to me and suggest that he might get me to have a look at it sometime . . . "when I find time to get it out of the cabinet."

A few months later he reported more trouble. This time it was a form of distortion, most apparent on records but, I suspected, only because of a natural tendency to play these at a somewhat higher level than the radio programs. As far as I could gather, the trouble occurred only on loud peaks when, to use his own description, ". . . everything seems to break up."

He went on to say that he thought it might be the speaker, since it was

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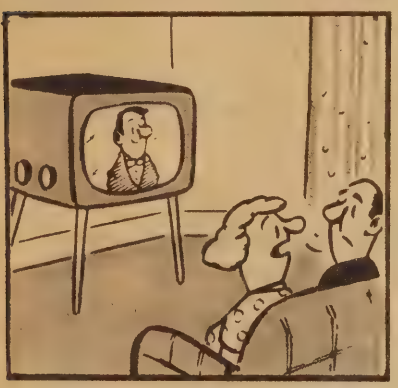
now getting rather long in the tooth and had had a fair amount of use. It was a fairly conventional, medium priced 2-ohm variety which, while regarded as quite good in its day, had been left far behind by present-day types.

Since, quite apart from any faults, it was undoubtedly the weakest link in the chain, I suggested that he might like to borrow a better quality job I happened to have available and compare results. Not only would this enable him to determine whether his existing speaker was faulty, but also to get some idea of the improvement which was possible with a modern speaker. He accepted the offer enthusiastically.

A minor snag concerned the change



"They say that colour television's on the way. But I'll believe that when I see it in black and white."

in impedance, the new speaker being a 15-ohm type. Fortunately, his speaker transformer had a tapped secondary, so that it was merely a matter of changing over the appropriate connections. In spite of his limited knowledge we both felt that, working to my instructions, he should have no difficulty in identifying the various leads. And so he went happily on his way, the new speaker tucked under his arm.

When next I saw him, about a week later, he was quite jubilant about the results, and it seemed that his diagnosis might have been correct concerning the old speaker. In any case, he was so impressed with the new one that he stated his intention to buy one like it as soon as he could manage it.

WORSE THAN BEFORE

Although I did not need the speaker immediately, and he was able to use it for the next couple of months, it had to be returned eventually, and the old speaker put back into service for the time being. I wasn't surprised when he expressed his dissatisfaction with it, even when he claimed that it seemed worse than before. I felt that such a reaction was only natural in the circumstances.

About this time, family pressure was brought to bear and the next thing I knew a TV set was installed in the lounge. And, of course, the radiogram was mentally pushed into the background. Apart from such mundane tasks as delivering an occasional news bulletin, time signal, or similar brief items, it was seldom switched on. It certainly had no need to deliver anything approaching high fidelity.

As time went by, however, some of the novelty of TV wore off, the family became more choosey in their selection of programs, and thoughts turned once more to the radiogram and the stock of good quality records which could provide a welcome change from the westerns and the who-dunits.

But first something had to be done about the speaker. While he was preparing to buy a new one I offered him the loan of another one I had on hand. This happened to be a 2-ohm variety, but was a modern, good quality type which should have been many times better than the old-timer it was to replace.

Unfortunately, things didn't go so well this time. Results were disappointing and he was beginning to wonder whether a new speaker was a proposition after all. In addition, the system had developed a definite noise level, a kind of crackling-cum-whispering sound which, by its description, could have been a noisy valve.

By now I was becoming suspicious. A few questions concerning the method of speaker connection and I was more suspicious. There seemed to be considerable doubt as to just what connections had been used and more than a possibility that both the old 2-ohm speaker, and the present one might have been wrongly connected, possibly accounting for the original complaint that the 2-ohm speaker sounded worse when it replaced the 15-ohm model.

RETURN TO SHOP

And so, at long last, I persuaded him to dismantle the whole set-up and bring it in to the shop, where it could be properly tested. After all, there is a limit to what one can do by remote control.

With the various units laid out on the bench and suitably connected together, I took stock of the general performance. There seemed no doubt that radio performance was poor, even though it brought in all the local stations and made a half-hearted attempt at a couple of the nearby country transmitters.

This one was easy. Running over the circuit with the multimeter, I quickly pounced on the screen supply for the 6N8 IF amplifier. This was only a few volts and a check with the ohm meter confirmed my suspicions. The screen dropping resistor, supposedly .1M, was up over 1M. I assume it had simply deteriorated with age, as so many of these seem to do.

A new one restored most of the lost sensitivity, and a "touch up" of the various alginment slugs with the aid of the generator completed the job. So that was one out of the way.

Next I turned my attention to the crackling-cum-whispering noise, mainly because it chose that particular time to present itself. Pulling out the tuner made no difference, but the effect vanished when I unplugged the control unit. I wasted no time plugging it back in and starting on it in detail while it was in the mood.

Shorting out the grid circuit of the EF86 made no difference, thereby excluding all the frequency compensating network ahead of it. In fact, there was very little left apart from the 22K plate load and the EF86 itself. While it could have been either—EF86s are not always above reproach—it happened that replacing the resistor was easier in this case, mainly because I had no spare EF86 on hand.

Tacking a new load resistor temporarily into place cured the trouble immediately, but when I slipped the old one back into circuit it was as bad as ever. So I considered the point proved and

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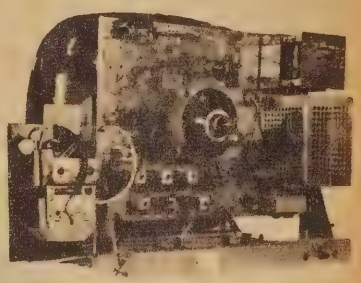

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General Accessories Pty. Ltd., Box 23, Post Office, CHIPPENDALE.
Radio Despatch Service, 841 George Street, SYDNEY.
United Radio Distributors, 175 Phillip Street, SYDNEY.
Albert Wright, 793 New Canterbury Road, HURLSTONE PARK.

QUEENSLAND
Chandlers Pty. Ltd., Albert Street, BRISBANE.
Tracksons Bros. Pty. Ltd., 157 Elizabeth Street, BRISBANE.
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VICTORIA
Electronic Developments, Nicholas Bldg., 37 Swanston Street, MELBOURNE.
Homecrafts Pty. Limited, 100 Leicester Street, CARLTON, N.3.
Howard Electrical and Radio Co., Vere Street, RICHMOND.
Master Electrics Pty. Limited, 547 Elizabeth Street, MELBOURNE.
Plastic Supplies Pty. Ltd., 208 Little Lonsdale Street, MELBOURNE.
Radio Parts Pty. Ltd., 562 Spencer Street, MELBOURNE.
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chalked up a victory against trouble number two.

But these were relatively simple faults. The real problem was this rather intangible distortion which had been the subject of so much discussion. Was it due simply to various speaker faults and/or incorrect speaker connections, or was there something fundamentally wrong with the amplifier?

Since the owner's original speaker connections had been pulled down in the process of dismantling the gear, I had no means of knowing whether my suspicions concerning these were correct or not. All I could do was set things up correctly and check the amplifier's performance.

MORE DETAILED CHECK

I had already conducted a rough listening test in the process of tracking down the earlier faults and, as far as I could tell, the amplifier seemed to be behaving normally. It looked as though I would have to make a more detailed check if I was to find the trouble.

First, I disconnected the speaker voice coil and substituted a heavy-duty 15-ohm resistor and across this I connected the CRO and the VTVM set to read AC volts. To complete the set-up, I fed a 1,000-cycle tone into the control unit.

This set-up duly produced a clean sine wave on the CRO screen and I wound the gain up until it showed signs of overload. This seemed to occur at a reasonable level, though it was by no means balanced, the "lower" 6V6, the one driven from the cathode of the phase splitter, being the first to overload.

The most likely cause seemed to be a weak 6V6, and this was checked by simply swapping these two valves in their respective sockets. However, the unbalance did not change over with the valves, remaining with the "lower" socket, suggesting that it was a circuit fault.

I considered the next most likely cause would be lack of balance between the plate and cathode loads of the phase splitter, due to a change in resistance values.

A check at the grids with a CRO did indicate some unbalance, though, intuitively, it did not seem quite enough to account for the unbalance at the plates.

MARKED IMPROVEMENT

However, I fished out a much larger value resistor, something around 1M or a little less as I remember it, and shunted it across the phase-splitter cathode load resistor. This produced a marked improvement and, by a little juggling of values, I was able to produce a virtually balanced overload characteristic.

Then I made a more detailed check of the power output. This worked out at between seven and eight watts; a not unreasonable figure in the secondary winding of a nominal 10-watt amplifier, particularly as I had no idea of the supposed efficiency of the transformer. All things considered, I felt that trying to flog anything more out of it could well prove a waste of time and achieve nothing.

One other possibility occurred to me; supersonic oscillation. In particular, I was worried about the possible effect of a fairly long voice coil lead, the speaker system in the old fireplace being on the opposite side of the room from the amplifier.

In some cases, where an amplifier is on the verge of instability, anyway, the presence of a small amount of capacitance across the voice coil may prove the traditional "last straw," and a long lead could well provide this capacitance. Accordingly, I connected various values of capacitance into this part of the circuit, but the amplifier remained perfectly stable for values far in excess of what could be produced by the lead.

So that seemed to be that. The minor problems had been corrected and, as far as I could see, there was nothing fundamentally wrong with the amplifier. I could only revert to my former theory of wrongly connected speaker leads.

And on that note I was about to pull everything apart preparatory to returning to its owner. But before I could do so, the speaker suddenly gave forth a series of hisses and crackles much worse than anything it had produced so far. Almost instinctively, I spun the volume control back to zero as a first step to isolating the stage. When this control had no effect, I knew it was somewhere "after" this point in the circuit.

LACK OF BALANCE

Next, I unplugged the control unit and, when this had no effect, I started pulling out the 6J7. But it wasn't necessary. One of the 6V6s was getting awfully red in the screen by this time and I simply reached for the power switch and then the multimeter.

There was no doubt about it, of course, that half of the primary was completely open circuit, and I began to wonder whether this was merely the culmination of a half-hearted defect which had been in existence for some time. If so, was it the cause of the mysterious overload characteristic we had been chasing, as well as the unbalance when everything seemed to be okay?

I may never know for sure, but it is significant that, when a new transformer was subsequently installed, I was able to remove the shunt resistor I had fitted to the cathode load and still produce an almost perfectly balanced overload characteristic. There seems little doubt that the real lack of balance had been in the old transformer.

MAIN TROUBLE

All of which simply goes to show how easily one can be caught. Had the transformer not chosen that particular moment to blow its top, it is inevitable that I would have returned the amplifier to its owner with the fault still in existence.

When I subsequently demonstrated its performance (using a good-quality speaker), the owner had no hesitation in going ahead and buying the new speaker he had been contemplating for so long. And, knowing that the system would now feed a 15-ohm speaker, I took special care to see that only the appropriate connections were available for use. I wanted to be certain there was no doubt about impedance matching this time.

A week or so later I was able to enquire as to how the system was working. The owner was jubilant. "It's going beautifully," was his enthusiastic reply.

"You like your new speaker?"

"Oh, I haven't got around to putting that in the enclosure yet. The set is

(Continued on Page 78)

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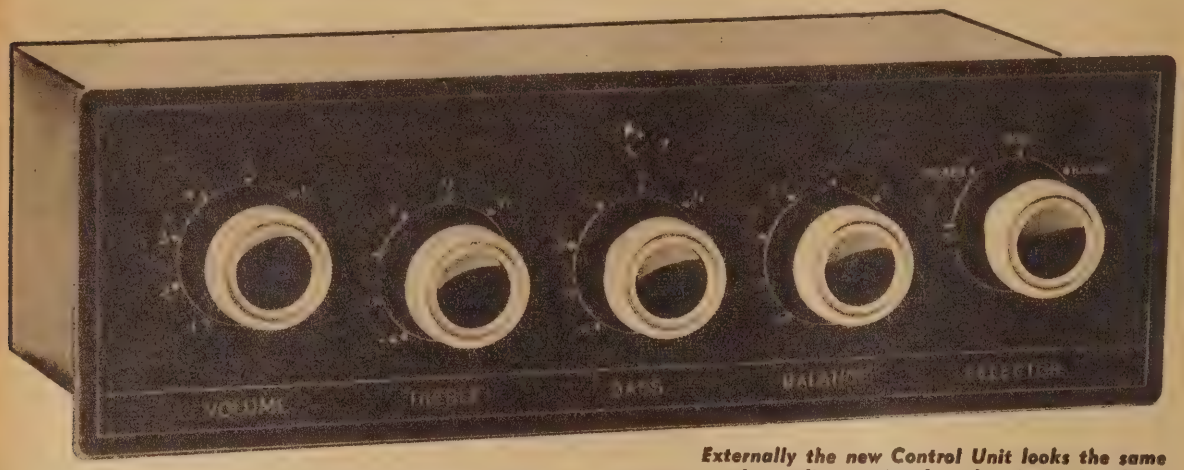


Externally the new Control Unit looks the same as the earlier version but the circuit has been modified and the internal construction is quite different.

New Control Unit Gives Higher Gain

This modified version of our high-gain Stereo Control Unit features increased gain, an improved balance control system and a new method of construction which makes all components immediately accessible under removable lids. It is suitable for use with any magnetic pickups currently available on the market.

By Neville Williams and Wes Yashin

FOR as long as it has mattered, the majority of hi-fi enthusiasts have preferred magnetic pickups because, in the ultimate, they are capable of giving better results than crystal or ceramic types.

Such results are not automatic, however. Not all magnetic pickups have been above reproach and, in any case, if used with limited equipment, the overall performance can be very disappointing indeed. In fact, it can fall well below that of a good crystal or ceramic type.

MAGNETIC PICKUPS

Those who would use magnetic pickups have conventionally had to contend with two difficulties:—

(1) Low signal output voltage and

(2) The need for substantial bass boosting.

The low output voltage is partly the result of the low efficiency of practical electromagnetic "generating" systems. What is more, knowing what is expected of magnetic pickups, manufacturers tend to sacrifice output further in the interest of level response, low distortion and high compliance.

The need for bass boosting arises from the fact that magnetic generating systems tend to produce an output voltage proportional to stylus velocity. Since this diminishes with frequency on an ordinary lateral recording, so does the output. Hence the need for bass boost and, as a rule, treble attenuation.

What was already a problem with mono pickups and records became doubly so with stereo because, by the time requirements of compliance, response, separation, etc. had been met, the available output for a given design approach had been reduced even further.

As a result, some of the pickups currently on sale reckon output in terms of just a few millivolts per channel. The associated amplifier therefore needs to have the order of gain traditionally provided for microphones, with the added problem of boosting the bass by some 15 decibels.

In practice, it is quite difficult to meet these requirements without running into amplifier hiss, hum, microphony and instability — any or all of which can ruin one's enjoyment of recorded music.

It may be argued that pickup manufacturers are asking too much of the amplifier and that may be true in part. They have their own problems, however, and very good reasons why it may be uneconomic and impractical to alter their suspension system or their magnetic circuit or their coil details or other things you may care to name.

A step-up transformer ahead of the preamplifier valve is an easy method, at first glance, to obtain signal voltage step-up. But a transformer of the necessary ratio, with the necessary distortion and response characteristics, and shielded against hum pickup, becomes a very costly item.

And you need two of them for a stereo system.

Transistors? These may offer a way out of the difficulty but their use is not without its own complications. Apart from the job of integrating them with valve circuitry, there remains the fact that they may have to be hand-picked for noise characteristics, which manufacturers don't seem to be happy to do at the moment.

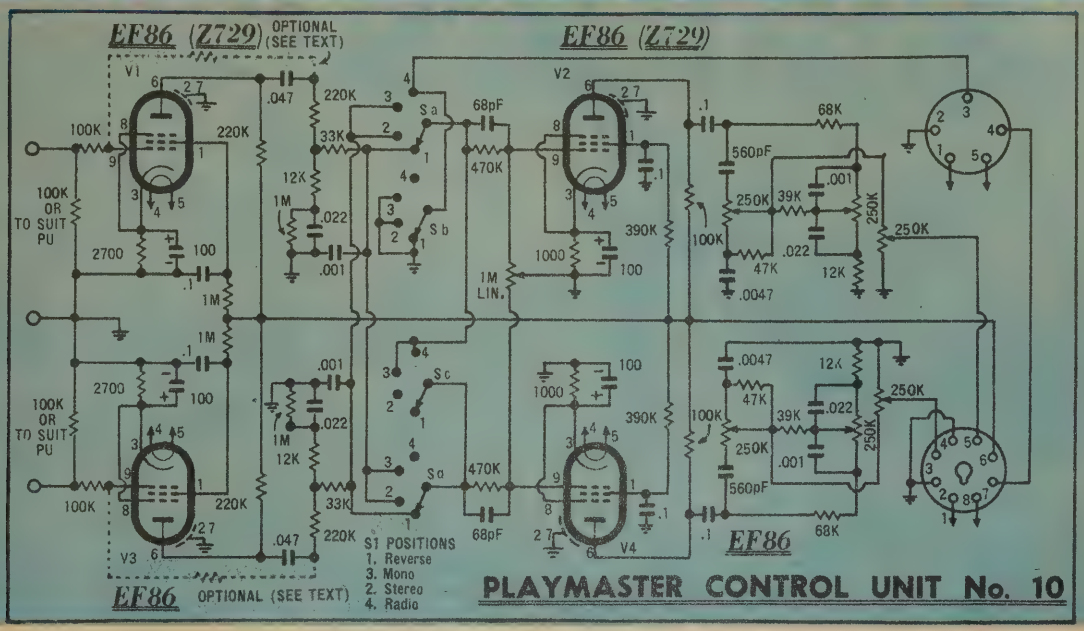
NO SIMPLE SOLUTION

So, for the time being, we are back at our starting point. If you want to use a magnetic pickup, you must be prepared to go to considerable lengths with design and circuitry, particularly for the lowest output types.

The high-gain stereo Control Unit described in the June, 1959 issue had ample gain for the pickups we had on hand at the time. There was talk of pickups with both higher and lower average output but little to indicate which way things were likely to go.

It seems now to be indicated that

ADEQUATE GAIN FOR ANY MAGNETIC PICKUP



The circuit contains about the same number of components as previously but it has been modified to increase gain and give wider control of balance. Note that feedback can still be used over the first stage if the pickup output is higher than anticipated.

quite a few magnetic pickups are to have quite low orders of output and that a "universal" pre-amplifier unit must have gain enough to drive the system to adequate power with about 10 millivolts of input.

The figure can only be a vague one, because the power sensitivity of the equipment enters into it, the level which individual listeners regard as adequate, and the level at which the discs themselves are recorded.

With this in mind, we carefully examined the circuit of the original High-Gain Stereo Control Unit with a view to finding ways and means of increasing its natural gain. We preferred not to depart from the present arrangement of two type EF86 (or equivalents) per channel, because these valves have proved themselves, in general, to be consistently quiet in operation.

MAXIMUM GAIN

As a first step, it was obvious that no feedback could be allowed around either stage if maximum gain was to be achieved. This is of no great consequence because, with such low orders of input as were anticipated, there would be little chance for significant distortion to develop.

At the same time, feedback can be added easily enough if, in individual cases, it is subsequently found that there is gain to spare.

As a second step, we increased the plate load resistor of the first stage from 0.1 to 0.22 meg, and increased also the resistor at the lower end of the output divider system.

Both steps, aimed at increasing the gain, slightly modified the frequency correction characteristic and necessitated changes in the capacitive values to maintain the RIAA characteristic. In fact, the characteristic correction is still quite accurate.

The output network in the second stage came in for similar treatment, at least in respect to the compensation system. With the new values, the "level" position is indeed level, tests showing that the bass and treble knobs could be set so that the maximum deviation did not exceed about 0.5db from below 50cps to at least 20Kc.

On either side of the balance positions, the tendency is for the bass boost to be slightly greater than the available bass cut, while the treble cut is greater than the treble boost. This is consistent with likely requirements but, in any case, there is plenty of each facility for normal use.

Additional gain could be obtained from this whole section of the unit by the simple expedient of multiplying all resistor and potentiometer values by 2, including the plate loads, and reducing all the relevant capacitance values by the same factor.

However, this would have involved the use of a 0.5 meg. volume control and we would have needed to be somewhat more discreet in the choice of output coupling cable, to avoid possible capacitive losses. Happily enough, the step did not prove to be necessary.

CONTROL ARRANGEMENT

While examining the circuit, we also took a further look at the "Balance" provision which operated in the last unit, in the cathode circuits of the second pair of EF86s. While it provided ample gain variation for balance purposes, it did not allow either channel to be cut right off.

Actually, it is very handy to be able to silence each channel at will. In use, the control can be swung quickly be-

PARTS LIST

1 Front panel, sub-chassis and metal work.
1 Label for front panel with knobs to match.
1 2 x 5 x 2 Oak switch.
4 Noval sockets.
1 Octal socket and cover.
1 Octal plug and cover.
1 Octal plug (chassis type).
1 5-pin socket.
2 Input connectors (Utilux).

VALVES

4 EF86.

RESISTORS

Standard ½ watt types:
2 470K, 2 1meg, 2 390K, 2 100K, 2 2700 ohm, 2 1000 ohm, 2 value to suit pickup loading and 2 values for feedback if required.
High stability ½ watt types:
2 220K, 2 100K.
5% tolerance, preferably high stability, ½ watt types:
2 220K, 2 1meg, 2 68K, 2 47K, 2 39K, 2 33K, 4 12K,
3 250K dual matched log. potentiometer.
1 1meg linear potentionmeter.

CAPACITORS

4 100 mfd 3 volt electrolytics.
6 .1 mfd 400 volt.
2 .047 mfd 400 volt.
5% tolerance midget types.
4 .022, 2 .0047, 4 .001, 2 560 pF, 2 68 pF.

SUNDRIES

1 bezel, lamp holder and lamp, 1 9in length of component strip, 2 3-lug tag strips, coaxial cable, tinned copper wire, spaghetti, hook-up wire, nuts and bolts.

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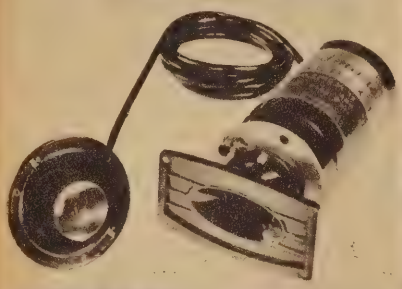

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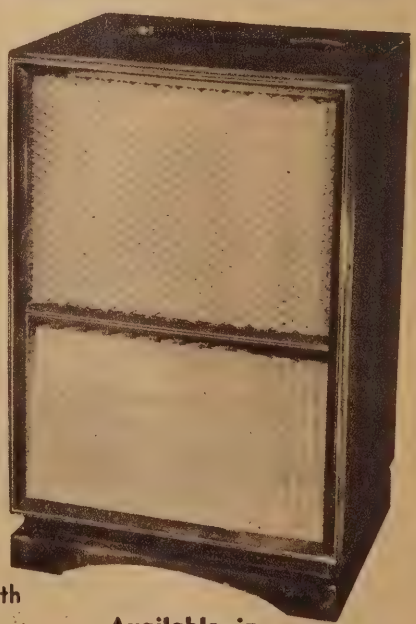

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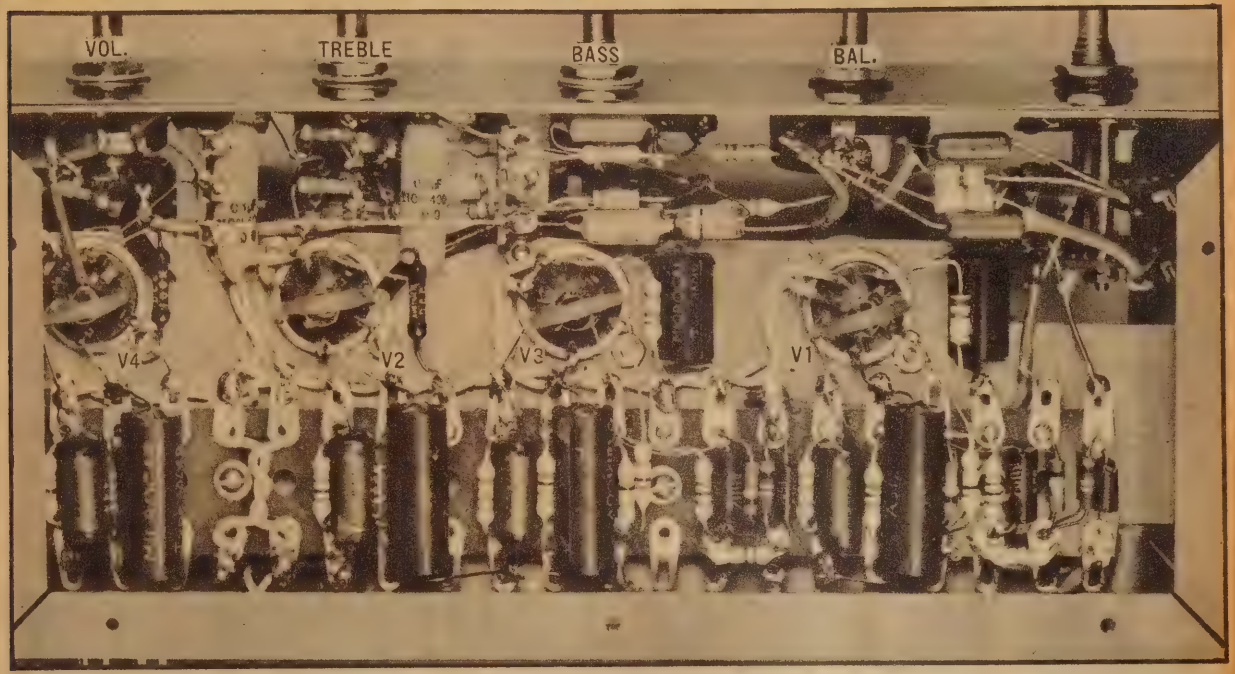
UNDERNEATH VIEW SHOWS WIRING DETAILS



This view underneath the chassis shows the ready accessibility of the wiring. The component panel is best wired before installation, the relevant connections then being made to the sockets. Some of the components attach directly to the potentiometers and switch.

tween its limits, to hear the content of each individual channel, then rocked back into a central position to give suitable balance between the two.

Again, it allows the system to be used as a true mono outfit by switching the Function knob to "Mono" and silencing one speaker or the other. While, in practice, you may not want to do this very often, the fact remains that the new control arrangement does allow for it.

A slight treble loss was evident across the series input resistors and, while this could be taken up easily enough by the treble control, we chose to balance it out on the spot by the use of two small compensating capacitors, as shown in the circuit.

BASICALLY SOUND

We have suggested the use of high value cathode by-passes, mainly because components of this rating are now available and they do make a slight difference in the very low frequency response.

For the rest, the design follows the lead already set by the earlier control unit, which proved so basically sound. Note that no high tension decoupling is provided in the Control Unit itself, the B-plus supply running straight to an output plug and thence to one of two lines to the main chassis.

This assumes that adequate decoupling is provided in the main amplifier chassis for both tuner and Control Unit.

Our practice, established during 1958 and 1959, is to provide a supply point for the Tuner, usually fed from the amplifier's main HT line through about a 2000-ohm heavy duty resistor, bypassed by a 50mfd. electrolytic. From this point, a 37 or 33K resistor, bypassed by a 100mfd. capacitor provides a supply for the Control Unit.

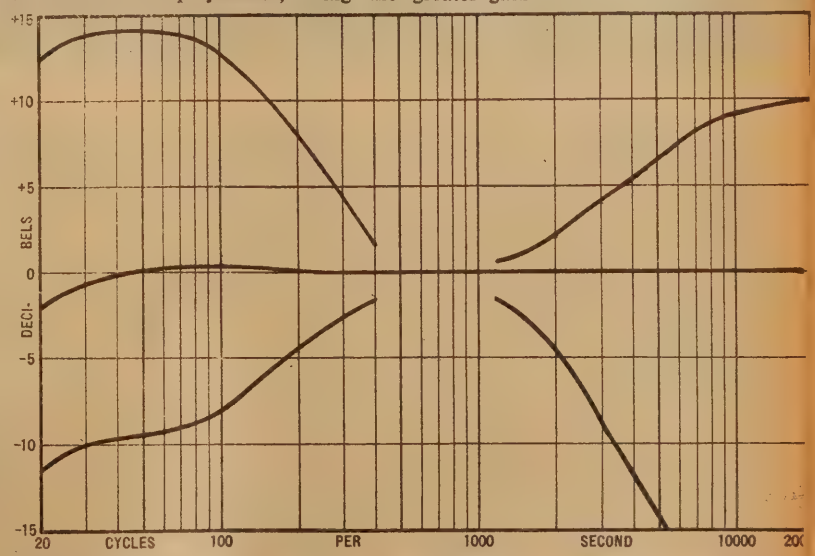
Both lines run to the Control Unit but only the latter one is used by it. The former is picked up by the Tuner, when plugged into the Control Unit. By plugging one unit into the other in this fashion, the risk of inducing hum by reason of earth loops is minimised.

Note also that neither side of the heater wiring is earthed in the unit. Once again, it is assumed that the heater winding will be tapped or returned through an adjustable resistor either to earth in the main chassis, or to a small positive voltage point.

In its new form, the Control Unit was tested with a 17-watt, a 20-watt and a twin 10-watt playmaster, being the ones which we happened to have on hand in our workshop. In all cases, the system was completely stable, the hum was virtually inaudible and, even with the gain control wide open, only a gentle hiss was evident from the speakers.

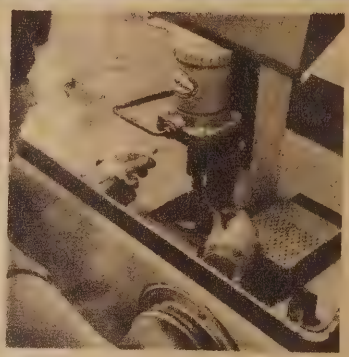
VIRTUALLY SILENT

But the important point was that, at this setting of the control, the output from an Elac variable reluctance stereo pickup was more than ample to run the system to overload. We mention the Elac in particular because people in the audio business have assured us that no currently available pickup would require greater gain.



This curve shows the response of the adjustable tone compensating stage with controls at the limit and balance settings. The fixed compensation curve for the first stage conforms to the RIAA characteristic.

35 reasons why*



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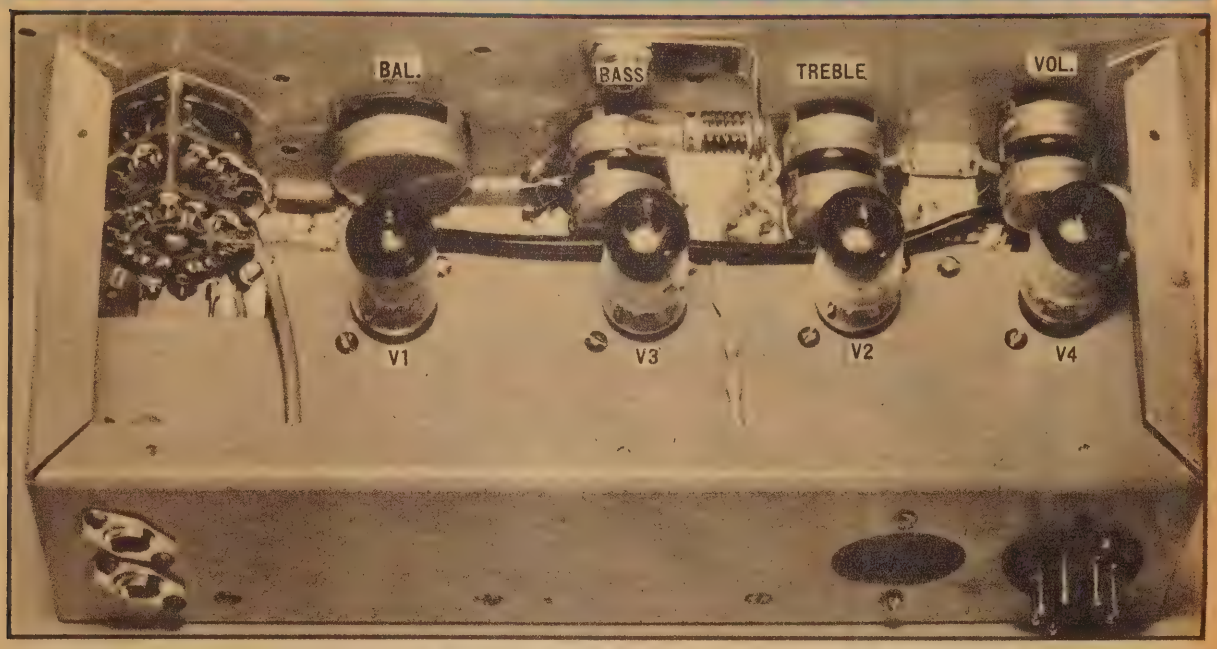
TOP VIEW OF THE HIGH-GAIN CONTROL UNIT



There is ready access above the chassis to the supply plug, the tuner socket and the pickup input sockets. Internal decoupling components are not required with current designs but there would be room to add them, in special cases, in the space behind the valves.

With the gain control set for normal listening, the amplifier can be reckoned as virtually silent.

In the light of all this, some readers who may have the existing unit but wanting more gain, could modify it to include the new circuitry. Actually, there is no inter-dependence between the two pairs of stages and the new constants could be substituted independently in either pair.

COMPOSITE WHOLE

There would be no need to modify the balance control arrangement unless you want to.

A second major consideration about the original Control Unit had to do with its physical form, the pairs of stages being built on separate angle brackets. While the actual wiring of these units is simple enough, it does tend to become obscured as all the pieces are assembled into a composite whole.

Accessibility for service is not as good as it might be.

Spurred by our experience with the Program Source, we therefore examined the possibility of building the entire Control Unit on a single flat chassis within the box. You can see the result from the photographs.

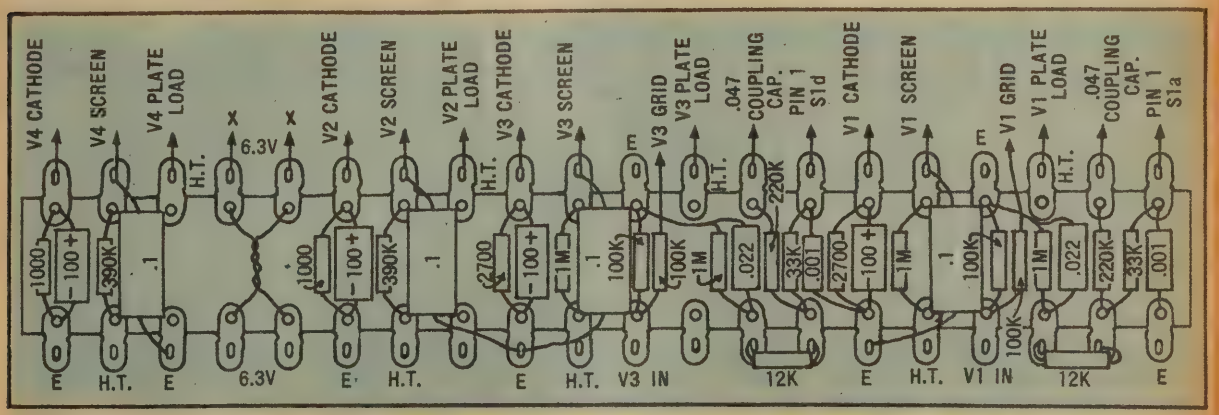
Removing the two lids gives complete access to all the valves, controls and wiring. Underneath the flat chassis, a large number of the components are concentrated on a tagstrip running the length of the box. The remainder of the small components attach directly to the controls with which they are associated.

With this method, virtually every component is accessible for checking or substitution, should this ever become necessary. Only one point is essential: The components must be modern miniatures throughout, otherwise they simply won't fit in without double banking.

Now for some constructional details. The metalwork is essentially the same as that used in the original high-gain control unit, with the exception of the sub-chassis which now replaces the brackets.

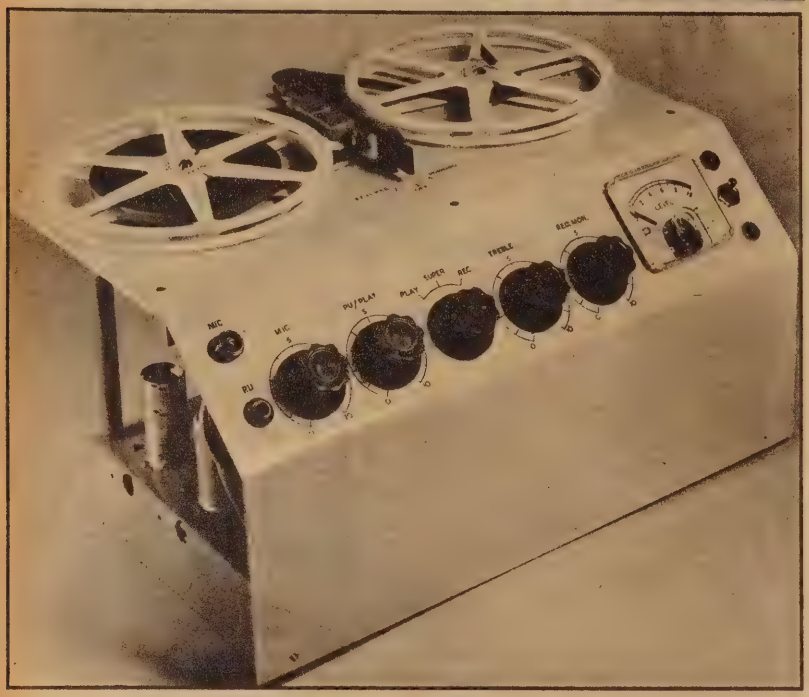
The sub-chassis has a number of cut-outs to clear protruding components, as well as the regular valve and screw holes. Blueprints of the sub-chassis to fit the original metalwork will be made available to chassis manufacturers. Individual constructors who wish "to roll their own" should have no difficulty in duplicating our prototype by simply judging the relative position of the major components.

A study of the accompanying photographs will disclose that the cut-out along the front edge of the chassis is not uniform and that two extensions have been left to fit between the volume and treble controls and between the treble and bass controls. These extensions are left as supports for tagstrips acting as anchor



This diagram is intended to indicate the order of components on the wiring panel. In using it, check constantly to see that the connections being effected are in line with the complete schematic circuit, which should be regarded as the final authority.

RECORD-PLAYBACK AMPLIFIER



For the past two or three weeks, staff member Jamieson Rowe has been working on this new design for a tape record-playback amplifier. Designed for ready adaptation to the variety of decks, which readers are likely to have on hand, it incorporates facilities not normally found in simple tape recorders. Full mixing facilities are included, with further provision to superimpose speech on what is already recorded on the tape. Multiple output impedances are available for external speaker and programs can be monitored at any desired volume through the speaker as they are recorded. Unless there is a last-minute hold-up, we expect to feature the design next month.

points for components grouped around the bass and treble controls.

The method of assembly for the metalwork and other components is as follows: Commence by mounting the input and output sockets along the rear of the box. Next mount the valve sockets on the sub-chassis and then attach this to the box. Follow this by attaching the front panel, and finally the controls along the front panel, which also hold the label in place. Countersunk screws should be used on the front panel and the sides of the box.

SWITCH CONTACTS

Since a large number of the contacts on the switch are interconnected, it is wise to pre-wire this item before mounting.

Most of the minor components can be assembled and pre-wired on a components strip, which is fitted into place after the sub-chassis has been installed. A coded wiring layout diagram of the component strip has been reproduced to facilitate assembly and no difficulty should be experienced in this regard.

The components mounted on the strip include the cathode and screen resistors and their bypass capacitors, grid leaks and isolating resistors and the recording characteristics compensation constants. The components not included on the strip are the plate loads and coupling capacitors, as well as the components in the tone control network.

There are two varieties of component strip normally available. One, the type used in our prototype, has a slightly closer lug spacing than the other. Either type may be used, the wider spaced type necessitating a minor variation in wiring.

In the prototype 20 lugs were required, spaced in such a manner that two lugs near the left-hand end were not required for components. The vacant lugs were used to anchor and terminate the incoming heater leads. Should you use a strip with wider spaced lugs, the heater leads could be run directly to the valve sockets, allowing the components to be brought closer to the left by two lugs, thus removing two lugs from the total length.

The wired components strip is mounted on the chassis by means of three screws, stood off with nuts. The spacing between the strip and the chassis will be about ¼-inch and care must be taken in wiring to ensure that there are no blobs of solder and whiskers of wire to cause a short to chassis.

A number of lugs on the component strip are common and must be interconnected. Hookup wire may be used for the job, which may be done on the under side of the strip. To prevent unnecessary heating and reheating of the lugs, precut your leads to the required length and perform a single soldering operation for each pair of lead-ends.

Having wired and installed the strip, it now remains to link up the lugs to the socket pins either directly or through other components. Tinned copper wire is quite suitable for this job and need not be insulated for the short and direct runs involved.

Orientation of the valve sockets is quite critical in order to reduce lead length and maintain neatness. The four sockets are mounted with pin 1 adjacent to the component strip. Referring to the underchassis view, the socket line-up from left to right is V4, V2, V3, V1. The component strip is wired accordingly.

The four plate load resistors are suspended between the appropriate lugs on the strip and the valve socket pins. The coupling capacitors in the first stages of each channel are connected likewise. The coupling capacitors in the second stages are anchored between the appropriate socket pins and lugs on the 3-lug strips mounted between the volume and treble and between the treble and bass controls.

OTHER COMPONENTS

The 3-lug strip on the right also supports one end of each of the 68K resistors and 560pf capacitors in the tone control network, the remaining components of the tone control network swinging between the appropriate potentiometer lugs.

Commencing with the treble control we have two 47K resistors connected between the moving arm and the earthy end lugs of the potentiometer. From the moving arms too, we have two 39K resistors going to the moving arms of the bass potentiometers as well as two connecting leads to the hot lugs of the volume controls.

From the hot lugs of the bass and treble controls we have two 68K and two 560pf resistors and capacitors respectively terminating at the 3-lug strip with the appropriate ends of the coupling capacitors. Between the moving arms and each of the ends of the bass potentiometers we have the .001 and the .022 mfd capacitors while the earthy lugs are connected to earth through two 12K resistors.

Suspended between the balance control and the function switch are the 470K resistors and the 68pf correction capacitors. From the balance control, too, are the connecting leads to the grids of each of the second stages. For safety's sake these leads should be shielded, coaxial lead being ideal for this purpose.

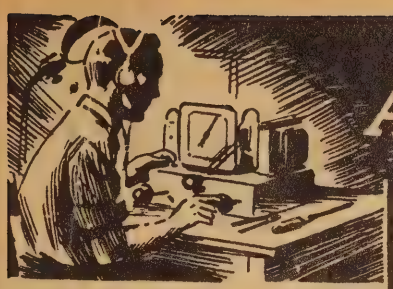
SHIELDED LEADS

Other leads which it is advisable to shield are those from the input connectors to the component strip, the outgoing leads from the volume control potentionmeters to the plug on the rear of the box and the lead from the tuner socket to the switch.

The interconnecting plug and tuner socket on the rear of the box are wired in standard Playmaster fashion. An interconnecting cable is required and should terminate in an octal socket at the control unit end and an octal plug at the amplifier end. Ordinary hookup wire is quite suitable for the HT, heater and earth runs while the audio leads must be shielded, preferably using low capacitance coax. cable.

It now remains to place the covers on, connect up the units and give them a trial run. At this juncture we could do well by mentioning, as we have often done in the past, the dangers of earth loops occurring through the connection

(Continued on Page 123)



A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

EQUIPMENT CABINET ON BRICK FOUNDATIONS

"The House That Jack Built" was the original title of this month's unusual contribution submitted by Mr. A. J. Barnes of 11 Wilkinson Lane, Telopea, N.S.W. More particularly, it is an account of Mr Barnes' trials and tribulations in the pursuit of high fidelity, ending with a successful, if somewhat drastic, method of suppressing acoustic feedback and floor vibration. We quote his article verbatim:—

YOU know how the old rhyme goes, it starts off with a cow with a crumpled horn and a maiden all forlorn and goes on and on; so it seems with stereo.

At first we were content with a modest amplifier, crystal pickup and medium-priced turntable. Believe me, we had a lot of fun with the outfit but you know how it is; you build a thing, get it going well, then start poking around to see how you can make it better.

The amplifier, an "R. TV and H" twin ten-watter, remains unchanged. It is hard to see how it could be improved and, as John Moyle says, twenty watts of audio is really summat. Our first change was to a magnetic pickup and pre-amp to suit. To date this is the best change we have made, because the improved fidelity is really worthwhile.

Change number two was the building of a couple of colossal folded horns to replace the modest boxes and a couple of "thirty-quid" speakers to replace the humble "six-quid" jobs. Honestly, the only apparent difference noted is the fact that the expensive speakers can handle the full output of the amplifier without doing a double somersault.

RUMBLE AND HUM

By now we had a really potent outfit but this lifted the lid off stereo's public enemy number one—rumble and hum. By various crafty means we got rid of the hum pickup problem but the pickup grumbled and muttered—it is the very nature of the brutes so to do, if the motor is at all noisy. (See "vertical compliance.")

We must remember that the modern hi-fi magnetic head has very low output, calling for amplification almost down to microphone levels. Blow me down—you can breathe on the things and hear it in the speakers.

Change number three then was the installation of a high-quality turntable and at least we had a potential twenty watts of audio with a noise-free background but we weren't finished yet.

She said, "Let's see if you've forgotten how to dance." So away we went for a few bars of hot jive (I think), but no sooner started than our three-gram pickup decided that the pace was too hot and, of its own accord, did a hop, skip and jump across to a slow waltz.

Now, we had previously noted acoustic feedback when bass passages were played at a level at which we weren't game to maintain for more than five seconds and had assumed it was resonance of the amplifier-turntable cabinet (one of these contemporary horizontal things on long legs).

So, much padding was applied to the inner walls of the cabinet, but it was the floor which was the trouble. The speakers vibrated the floor, the floor vibrated the cabinet and the cabinet vibrated the pickup and the maiden all-forlorn (er—pardon).

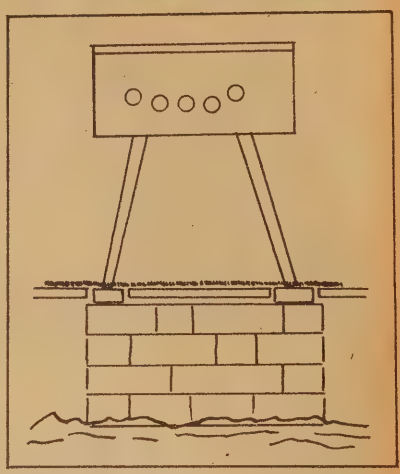
Fancy living next-door to the Barnses.

Now I wouldn't say our house is jerry built, its floor is as solid as most, so the only thing to do was to completely isolate the cabinet from the floor as we "greasers" do sometimes with machinery in factories.

So we came to the final project (to date that is).

We carefully decided the final-final resting-place for the cabinet, making sure that the legs were placed between floor joists. The cabinet moved out of the way, carpet rolled back, we then cut four-inch sections of floorboard away right where each leg would rest.

We could now see the ground below through four rectangular holes and enjoy the cool draught through them. (Gives me an idea for ventilating the house.)



Naturally, before we tackled this job we had made sure that there was a couple of feet or more between floor and ground below. Next we built a couple of single-course brick walls up to the holes in the floorboards with about a quarter of an inch clearance.

Sandwiches of caneite and rubber were placed on top of the bricks through the holes with clearance all around them. The tops of these packings were just a little higher than the tops of the floorboards. With carpet replaced and cabinet legs in the right spot, no one knows the skullduggery below.

No acoustic feedback now and no pickup skipping; you can jump up and down on the floor now to your heart's content.

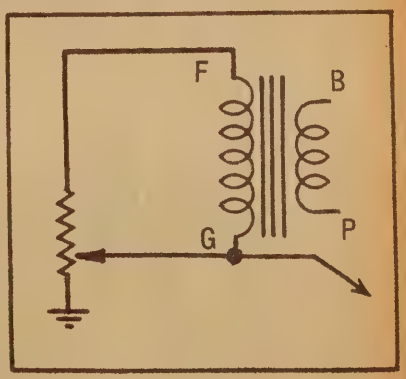
How crazy can you get?

IMPROVING BASS RESPONSE

The following suggestion for improving bass response was submitted by Mr G. B. Wolfe, of Chusan Street, Bombala, N.S.W.:—

An old Philips audio coupling transformer with a 3 to 1 ratio was used. This transformer has a very high impedance, connections to the windings being made by means of four screw terminals on the top. One half of the transformer only is required for this circuit, the grid or secondary winding.

The transformer winding is connected between the hot side and the moving arm of the volume control. This provides a shunt path for the low frequencies. Various settings of the volume control affect the middle and high frequencies in the normal manner, whilst the bass notes are fed straight through.



Here's your answer, Tom!

Judging by Tom's initial questions this month, it seems as if he must have been delving into some books on transmitting and radar. However, his last two questions are more general and refer to interesting points of theory. Satisfied that he is not neglecting his fundamentals, we will now attempt to answer his questions!

Q.: What is a "transposition block" and what are its uses?"

A.: A transposition block, Tom, is a small block, composed of a ceramic or other high-quality insulator, used in the construction of open-wire transmission lines. Small slots are arranged on the block so that the conductors of the line are anchored securely and also reversed or "transposed" in position.

The blocks are spaced along the line, preferably at unequal distances, and thus keep the two conductors of the line at the correct distance apart for the total length of the line, as well as transposing them.

RECEIVING, TRANSMITTING

The transposition is done, by the way, for two reasons. In a line used to feed a receiver from an aerial, it helps reduce the pickup of noise and other signals by the line. This is because the "average" position of both conductors of the line is in the centre of it and so there will be identical noise currents induced in each wire, producing no net current if the receiver input system is balanced.

Another way of saying this is that neither conductor is predominantly nearer to a source of noise than the other. One can also imagine that the currents induced in the conductors over one section of the line are cancelled by the currents induced in them in the next section.

In a line used for driving an aerial array from a transmitter, transposition helps cancel out radiation from the line itself. This is because waves radiated from adjacent sections of the line tend to cancel.

★ ★ ★

Q.: What is a "T-R" gas switch tube and where is it used?

A.: As the name implies, Tom, the T-R switch tube is used as a switch. In radar installations and other applications, where a receiver and a transmitter must use the same aerial alternatively, it is often impractical to disconnect the receiver while the transmitter is operating. Means must be provided to prevent the high power from the transmitter from damaging or otherwise interfering with the receiver.

One solution to this problem is to connect the receiver into the transmission line or waveguide either by breaking one conductor, or using a "Tee" piece in the case of the waveguide. A gas-filled tube containing two electrodes is then installed, shunting the receiver connections at the junction point.

This is the "T-R" switch tube, and it operates by acting as a short circuit when the transmitter is operating, thus protecting the receiver. The electrodes and gas in the tube are arranged so that the gas ionises at a level of applied voltage easily reached when the transmitter is in operation. The tube has a very low impedance, when the gas is ionised, and largely prevents energy from reaching the receiver.

DOES NOT IONISE

When the transmitter is not operating, however, the applied voltage on the tube is very low and it does not ionise. It thus represents a quite high impedance and allows signals from the aerial to reach the receiver normally.

The tube thus acts as an automatic transmit-receive switch in the aerial circuit, the name being shortened, in practice, to "T-R" switch.

★ ★ ★

Q.: What is a slotted line and what is its use?

A.: A slotted line is a waveguide section having a thin slot running along it longitudinally. As you possibly know, Tom, waveguides are used at frequencies in the "microwave" spectrum, above say 1,000 megacycles. They are used to transfer energy at this frequency from one place to another, similar to the operation of transmission lines at lower frequencies.

★ ★ ★

Like transmission lines, they have to be terminated in the correct impedances at each end, otherwise mismatch occurs, and standing waves are set up in the wave guide. As this causes loss of transmitted power, as well as heating of the waveguide, it is highly undesirable, and tests have to be performed to examine the cause and amplitude of the standing waves.

In a transmission line, this is generally easy, as the magnetic and electric effects of the standing waves are accessible to test gear. However, in a closed waveguide, it is not so easy, since the guide is usually of quite thick copper, and completely surrounds the signal.

One answer is to use a section of the waveguide in which a long thin slot is cut, enabling a sampler wire to be introduced into the guide and slid along it to investigate happenings at any desired point. A tuned cavity is usually connected to the sampler wire, and a detector circuit fed from this cavity.

The detector gives a DC output, and this output is proportional to the strength of the field present in the vicinity of the sampler wire. Thus, if in moving the sampler wire along the slotted line the DC output varies in amplitude, there must be standing waves present in the waveguide.

★ ★ ★

Q.: How can one get substantial shocks from the 6-volt side of a car ignition system?

A.: Strange as it may seem, Tom, there is more voltage present at times in the low voltage side of an ignition system than the 6 volts from which it is supplied. And it is from this higher voltage present that shocks are received.

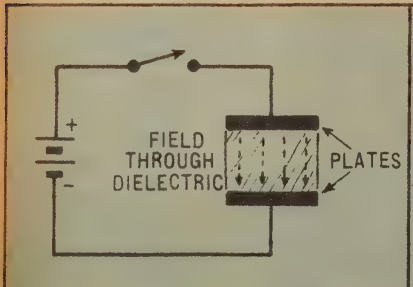


FIG. 1

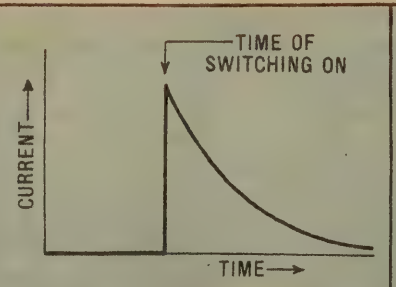


FIG. 2

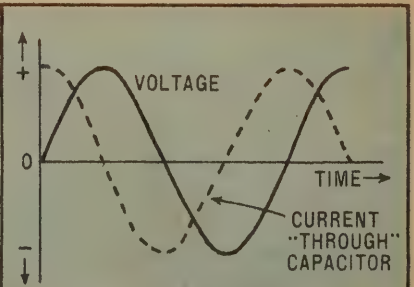


FIG. 3

The explanation for this lies in the fact that when the current in an inductive circuit, such as the primary of an ignition coil, changes value, or attempts to change value quickly, the circuit tries to prevent it doing so.

This means that when the distributor contacts close, allowing current to commence in the inductive circuit of the coil, the coil immediately reacts by producing a voltage which tends to stop the flow of current. This voltage stays there until the inductance is "charged," and

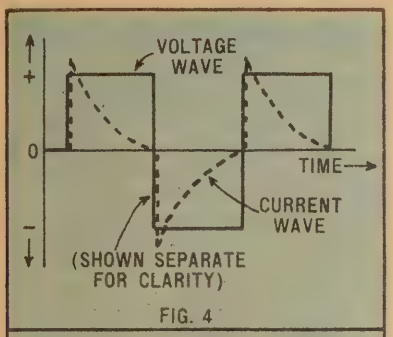


FIG. 4

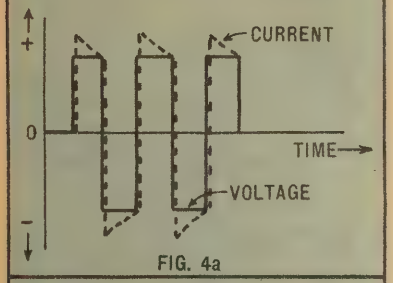


FIG. 4a

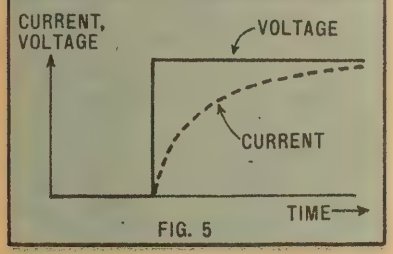


FIG. 5

then disappears, allowing the primary current to flow. "Charged" here implies that the magnetic field builds up to a value proportional to the applied current.

When the contacts open, the coil immediately produces a reverse voltage, which tends to keep the current flowing. Since the current has dropped to zero quickly, this voltage may be quite high, and can easily be felt as a shock.

The voltage produced by the coil is just the normal voltage produced by the build-up and decay of the magnetic field of an inductance. The voltage, which is produced by the primary coil inductance, is the one which can cause shocks from the "low voltage" side of system, and has little to do with the voltage in the secondary.

The two voltage pulses are related, however, because it is the same collapse of the magnetic field in the unit, which produces them both. Since it is induced in a winding with many more turns than the primary, the secondary voltage is much larger and able to jump the gap at the end of the spark plugs.

It is interesting to note here the effect of the capacitor used in most systems to protect the distributor contacts. The object of the capacitor is to bypass the contacts when they open, and thus prevent the pulse produced by the coil from developing an arc across the contacts.

The capacitor actually has a quite complex effect. There is no voltage across the points at the instant they open and it can only build up at the rate with which the capacitor can be charged.

Furthermore, the flow of current into the capacitor limits the rate of collapse of the magnetic field. In so doing, it becomes part of a resonant circuit, having a certain Q factor and across which a damped oscillation tends to occur.

For best results, there is an optimum value of capacitor.

★ ★ ★

Why can a capacitor, which has two connections which don't touch, pass a current and how does an inductor, which is a length of wire, not pass a current—or not much?

Well, Tom, we suppose this must seem very strange at first and it is true to say that a lot of us never quite get used to it.

To begin with, a capacitor never conducts a current in the sense that electrons pass through it in a continuous path as current flows in a wire. But it does produce an effect when voltage is applied to it, which can be imagined as a continuous current; as far as the rest of the circuit is concerned, that is the main thing.

Let's refer to the diagram (Fig. 1) and see if we can explain this effect. The main parts of a simple capacitor are the two plates and the material between them, called the dielectric. When a source of electromotive force (EMF) is applied to the capacitor, an electric field is produced in the dielectric.

This field set up depends on two main factors, governing the actual strength or intensity of the field; these are the material composing the actual dielectric and its thickness and the voltage applied to the plates.

MOLECULAR STRUCTURE

The electric field has an effect on the dielectric material, tending to distort its molecular structure.

As this distortion is not present when no field is applied, it follows that energy must be used to cause the distortion and, obviously enough, the energy is supplied by the field. But the field has been set up by the applied EMF, so a current must flow from the source of EMF to supply energy to the field.

The process described so far does not take place instantaneously, but takes a definite time to happen. It also does not progress in an even manner, but proceeds quickly at first and slows down gradually. If one were to plot a graph of flow of energy into the dielectric, which must also represent the flow of current from the source of EMF, it would look like figure 2.

The shape of the curve followed by the current is described as an "exponential" and mathematical equations have been developed which describe its quali-

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★ SPECIALS ★

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ties very thoroughly. So, from all this, we can see that, as far as the source of EMF is concerned, the capacitor draws a current which is great at first but diminishes as time progresses.

The diminution can be imagined as being due to the gradual distortion of all the molecules of the dielectric. Thus, when they are all distorted to a value which depends on the strength of the applied field, the current stops altogether. This takes a very long time, but the current soon drops down to a very tiny value, which is usually neglected.

SUPPLIES ENERGY

The current which flows into the capacitor, by the way, should not be imagined as flowing from the plates straight into the dielectric and out again. Rather it should be thought of as supplying energy to the field, which needs the energy to set itself up in a section of space where there are "millions of hungry molecules needing to be bribed with energy before they permit an electric field to be passed through them."

But let us now consider what happens when alternating current (AC) is applied to a capacitor. The nature of this type of current is that it reverses direction periodically. This is because sources of alternating EMF reverse polarity and, in fact, the graph of the generated voltage looks like the "sine-wave" of trigonometry (Fig. 3). The voltage reverses polarity twice every cycle.

WITH AC APPLIED

When AC is applied to a capacitor, current flows every time the current reverses and may not have time to drop to a very low level before the voltage reverses again. Thus the current may never drop to zero and, in fact, when a voltage is applied which varies amplitude with time, such as the sine wave mentioned, the current drawn by the capacitor looks very like another sine wave, only it differs in phase.

From all the foregoing, it should be obvious that if we apply an alternating voltage to a capacitor which looks like Fig. 4, the current will look like the dotted line, and is merely two versions of the exponential curve shown before per cycle, one being inverted.

If an alternating voltage of any waveform and very high frequency is applied to a capacitor, a queer thing happens. We find that the capacitor does not have time to drop its current much before the applied voltage reverses, and so the current must also reverse.

The effect of this is that the current waveform becomes very similar to the voltage waveform and so, if a voltage of practically infinite frequency is applied, the capacitor would act as a short circuit!

INDUCTORS

The reason why an inductor can appear as an open circuit is really quite similar to the reason given for the capacitor "short circuit," but it needs a small amount of separate explanation. The type of field set up in an inductor is not an electric one, but a magnetic, and it is set up in response to a current flowing through the unit, rather than the applied voltage.

Energy has to be supplied to an inductor to set up its magnetic field before current can flow through it. Thus the flow of current in an inductor, when an EMF is applied, is very slow at first, and then faster as the magnetic field builds up (Fig. 5).

This means that the waveform of current is a reversed exponential and exactly opposite to the current in a capacitor. Thus, working on the idea that an inductor behaves just the opposite to a capacitor, it can be shown that to a current which tends to change its value quickly, an inductor acts like an open circuit.

This can be seen from Fig. 5, for if the applied voltage changed in polarity before the current builds up much, the current would be forced to try to reverse before it had started to flow! So, if a very high frequency signal is applied to an inductance, the current doesn't get a chance to flow and the unit appears as an open circuit or, at least, as a very high impedance.

BLOCKS AC RIPPLE

This explains why inductors are used to block AC ripple or other alternating voltages from a DC power supply. As far as the steady DC is concerned, the inductor is merely a length of wire and it encounters only the DC resistance of the winding wire. But the AC finds that it has a very hard time trying to struggle through the inductance and, the higher the AC is in frequency, the tougher it finds the task.

An inductor used in this fashion in a circuit is called a "smoothing choke" and provides a very good way of stopping hum and other AC voltages from being delivered to a receiver or piece of equipment, along with its DC supply.

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A Simple 36 Mc. Sweep Generator

One of the most important pieces of test equipment for any TV enthusiast is a sweep generator and we are always on the lookout for any idea which will bring this device within easy reach of our readers. Here is a description of such an instrument in just about the simplest possible form. We feel it should have a very wide appeal.

by Philip Watson

IT is perhaps unfortunate that the advent of television has ended the era when the home builder required nothing more than a station signal, a keen ear, and an alignment tool in order to align his home-made equipment. But that is the price of progress.

PRACTICAL ALIGNMENT

The important thing is that we appreciate this limitation and accept the fact that there is no really practical method of aligning a TV set except by means of a sweep generator. Other schemes may permit something like the proper response to be approached but, at best, they are a substitute; a means of getting the set going and achieving a tolerably good picture until such time as the job can be done properly.

This being so we have to consider ways and means of equipping the average enthusiast with such a unit, and at a price he can afford. Commercial units are, of course, readily available but their cost (a de-luxe unit will leave little change from £200) is not only way out of reach but completely unjustified unless it is to be employed full time.

We have already described two such units for home construction, a basic sweep generator being described in the March, 1957 issue and a complete Sweep and Marker Generator in the following June issue. Finally, some minor additions were described in the August, 1958 issue.

Our original Sweep and Marker Generator is still performing as well as ever and has done a first class job in conjunction with our numerous TV projects. Similarly, thise readers who built this version appear to have been just as successful.

This instrument was built around a piece of disposals equipment, which was really a variable capacitor driven from a moving coil unit similar to a loud speaker voice coil. The scheme works particularly well, the only snag being a shortage of these vital units and, as a consequence, a fairly steep price when one is lucky enough to locate one.

VARIABLE PERMEABILITY

Fortunately, there are other ways of tackling the problem. Reactance valve circuits is one approach (though with reservations concerning the amount of sweep available) and variable permeability circuits is another.

We have long considered the latter as being most promising, but lack of a suitable basic unit has presented a problem. While it might be possible for individual readers to construct this themselves, it is quite critical in many ways, and could be difficult.

We were particularly pleased, therefore, when one of our advertisers (Prodis Electronic Instruments Ltd., of South Australia) came up with a sample of a very nice unit they had developed and a suggested basic circuit to suit it.

Preliminary tests proved quite promising, and we had no hesitation in going ahead with a full scale project. The final unit works particularly well, and should prove ideal for those who need a simple but thoroughly reliable instrument at a moderate cost. Not the least attractive feature is the comparative simplicity of the circuit.

As it stands, the instrument is simply a sweep generator intended to cover the TV IF band, with a fine tuning control to centre the pattern. No marker generator is provided, but there is an input circuit to accept a marker signal from a separate oscillator.

EXTERNAL MARKER

We adopted this scheme in the interests of simplicity, since we felt that there must be many readers who have available a signal generator which will cover the required band, either directly or with a readily identifiable harmonic. In such circumstances, it may be hard to justify the additional complexity of a complete sweep and marker generator.

On the other hand, there is no reason

why this circuit should not form the basis of a more complex instrument for those who require it, and we may well develop something along these lines in the future. Alternatively, you may have a go at it yourself if you feel up to it.

In the meantime, a brief discussion of the circuit and how it works will help the reader to gain at least a working knowledge of the principles involved. It will also give some indication of the practical problems which can arise when one sets out to develop a "simple" idea.

In any conventional tuned circuit comprising inductance and capacitance the frequency may be varied by any means which varies either capacitance or the inductance. In our original circuit we varied the capacitance, while in this circuit we vary the inductance.

VARYING INDUCTANCE

Fortunately, inductance is easier to vary by non-mechanical means than is capacitance. The inductance of a coil is dependent on, among other things, the "permeability" of the magnetic circuit surrounding the coil. If, therefore, we can evolve some way to vary this permeability at the sweep rate, we should be able to vary the inductance and, ultimately, the frequency.

One factor which governs the permeability of a magnetic circuit is the flux density at any instant. A well known example of this is the effect of DC flowing in a filter choke as used in an ordinary power supply.

It is a well known fact that the presence of this DC reduces the effective inductance and that various precautions, including the provision of an air gap in the magnetic circuit, must be taken in the design of the component. Similar problems arise in the design of single-ended output transformers.

Thus, by passing current through any circuit we can vary the magnetic flux, the permeability, and the inductance. This is the basis of the variable permeability system, an arrangement which is used in many commercial units.

More exactly, the system usually consists of two coils, the tuning coil and the controlling coil, sharing the same magnetic circuit. The tuning coil may be wound on a high frequency iron dust core while the controlling coil is usually wound on a conventional laminated iron core.

50 CPS SWEEP

For a sweep voltage it is convenient to use a 50 cps supply from a suitable transformer winding, with a similar voltage fed to the horizontal sweep circuit of the CRO in place of the conventional internal time base. However, in order to ensure that the frequency deviation is logically related to this CRO voltage it is necessary to add another function to our circuit.

This may be best understood if we consider the system, initially, without any voltage applied to the controlling coil. In these circumstances the permeability will be maximum, and the application of a voltage, regardless of polarity, will reduce the permeability. Thus the magnetic circuit will go through an excursion from maximum to minimum permeability for each half wave of ap-

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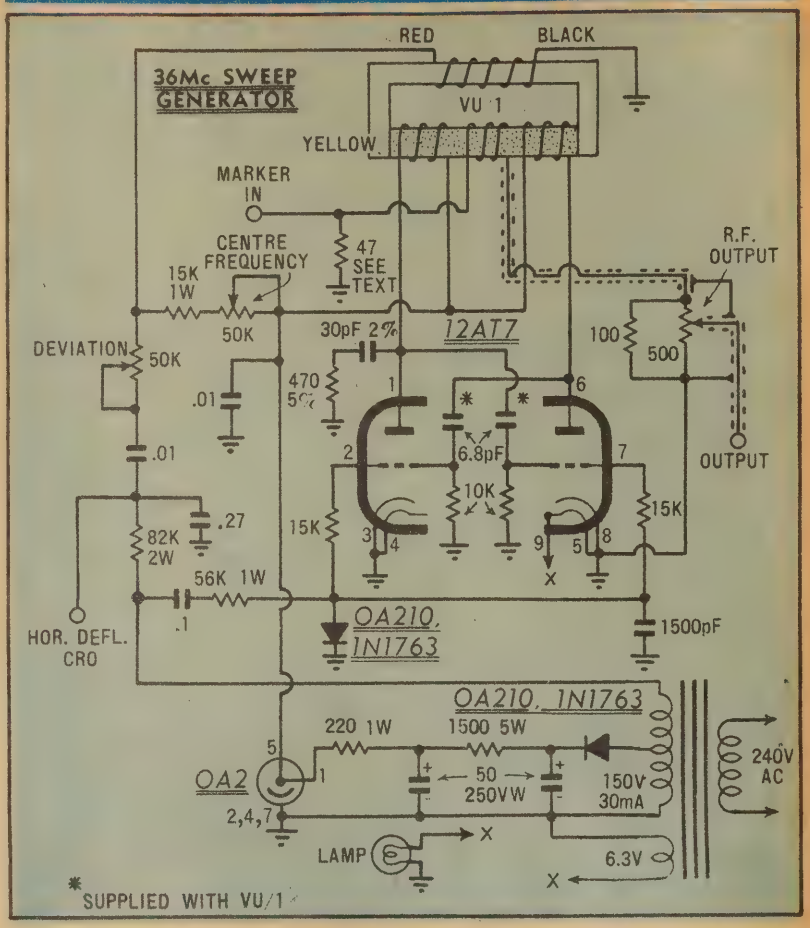

The circuit is relatively simple, the only special component being the sweep unit. The power supply provides a regulated direct HT voltage, plus an alternating voltage to drive the sweep unit.

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- 1 Case 9in x 6½in x 5½in. (with front panel)
- 1 Power Transformer 150-0-150 volts at 30mA, 6.3 volts at 2 amps.
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- 1 12AT7, 1 OA2.

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- 2 1N1763 or OA210.

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- 1 .33 mfd 200 volt paper.
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- 1 .01 mfd ceramic.
- 1 1500 pf ceramic.
- 1 30 pf 2% mica.
- 2 6.8 pf ceramic. (May be supplied with VU/1 unit.)

RESISTORS

- 1 470 ohms 5% ½w.
- 1 47 ohms ½w. (see text).
- 2 10 K ½w.
- 2 15 K ½w.
- 1 100 ohms ½w.
- 1 56 K 1w.
- 1 220 ohms 1w.
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plied 50 cps signal, or 100 times per second.

To overcome this, and also to ensure that the most advantageous portion of the magnetic circuit characteristic be used, it is necessary to apply an initial bias to the control winding. This will take the form of a suitable DC voltage superimposed on the AC sweep voltage.

The effect is to reduce the permeability by a fixed amount in anticipation of the positive and negative pulses from the sweep voltage. These will now either add to the bias voltage for (say) a positive pulse, thus reducing the permeability still further, or subtract from it for a negative pulse, thus increasing the permeability. As a result, the permeability goes through the minimum to maximum excursion 50 times per second.

IN PHASE

Since the spot on the CRO screen occupies a central position before the 50 cps sweep voltage is applied, and swings each side of this for positive and negative halves of the cycles, it will be exactly in phase with the 50 sweeps per second made by the oscillator.

The next problem concerns retrace suppression. This is necessary because a response curve will be traced on the CRO screen as the beam moves in both directions, i.e., one as it moves from left to right and the other as it returns from right to left. These will correspond to a permeability change from (say) maximum to minimum in the first case, and from minimum back to maximum in the second case.

Ideally, these two traces should exactly coincide but due to a number of factors, including phase shift in the CRO amplifier, and the hysteresis loop of the magnetic circuit they will always be displaced by a significant amount. Since this produces a very confusing pattern, some means must be employed to suppress either the forward or return sweep.

(This problem is not peculiar to the variable permeability type of instrument. It is inherent in the use of a sine wave as a sweep voltage, instead of the more complex saw tooth wave form sometimes employed. It was encountered in our previous unit, and overcome in essentially the same manner.)

SUPPRESSION VOLTAGE

In both cases we apply a suitable value of 50 cps signal to the grid of the oscillator so that, during the negative half cycle, the valve will be cut off and cannot oscillate. If the presence of the positive half cycle is likely to upset the operation of the oscillator a rectifier may be used to suppress this half, so that only negative pulses are fed to the grid.

However, there is another requirement to be satisfied, that of phase. The oscillator needs to be suppressed while the sweep voltage is moving from the peak of one cycle (say positive) to the peak of the opposite cycle. Using a 50 cps voltage in phase with the sweep voltage would provide suppression for only one half of this period and continue for an equal period into the next cycle.

To overcome this, we must interpose a phase shift network which shifts the voltage by 90 degrees and a simple resistance/capacitance circuit will achieve this quite easily.

And, finally, there is the problem of maintaining constant output over the swept range. The need for this need hardly be emphasised, since anything but minor variations would render the pattern meaningless.

Again, this problem is not peculiar to variable permeability systems, but they do have their own particular causes of variation. The most serious of these is due to the fact that the "Q" of the ferrite core material varies substantially with the permeability, resulting in serious variations in oscillator activity and output.

A popular method of overcoming this is to arrange a feedback circuit, whereby a sample of the oscillator output voltage is used to control a regulator valve in the oscillator plate supply circuit, thereby varying the supply voltage in accordance with the oscillator activity.

Schemes like this can be made very effective but, fairly obviously, call for a lot of additional circuitry, so that the instrument is rapidly moving away from the "simple" design originally envisaged.

The alternative is to tackle the problem when designing the basic unit in the hope that it may be made to give an essentially constant output without the need for complex circuitry. This is not easy, but it has been done in the case of the unit we are considering, and is a most important point. It means that the associated circuit is as simple as possible and represents a worthwhile saving in components and circuitry.

It also emphasises the point that these sweep units, while delightfully simple "in theory," are not necessarily so in practice. If, therefore, you have ideas about making one of these units yourself, be aware that there are a number of fine points of design which may not be immediately apparent.

Having thus reviewed the general requirements we can look at our circuit in greater detail and see how we satisfy these in a practical unit. The circuit is based on that suggested by the makers of the sweep unit.

The basic sweep unit (designated type VU/1) consists of three windings on a rectangular magnetic core. Three sides of the core are of laminated soft iron, and the fourth of high frequency ferrite rod. The latter is actually mounted within a plastic rod which serves as a coil former.

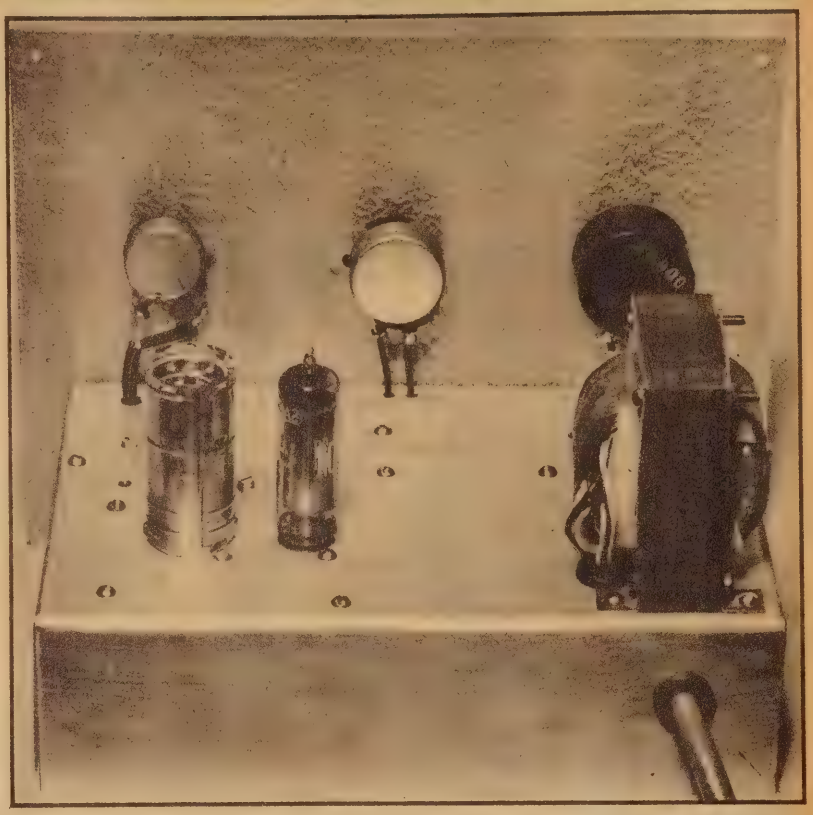
WINDINGS

The control winding, the largest of the three, is wound on the laminated core and the other two on the plastic former over the ferrite core. These consist of the main oscillator winding, wound in two sections and centre tapped, and a small pickup loop between these two sections.

It is used in conjunction with a 12AT7 twin triode wired as a simple push-pull oscillator. The frequency of oscillation is determined by the specifications of the unit so that, apart from minor changes, we cannot vary this to provide other frequencies. However, if we care to employ a second oscillator to beat with the sweep oscillator, a very wide range of frequencies can be covered.

A feature of this part of the circuit is the series network of a 30 pf capacitor

LAYOUT OF MAJOR COMPONENTS



This rear chassis picture gives a good idea of the major component layout. The shielded valve on the left is the 12AT7, with the OA2 alongside it. Controls, left to right, are: attenuator, deviation, and fine tune. Note the shielded cable connecting to the attenuator.

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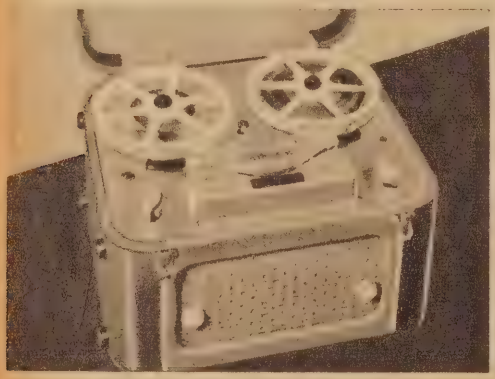

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and a 470 ohm resistor which connect between one side of the main oscillator winding and chassis. Their function, in conjunction with the design of the sweep unit, is to maintain a constant output over the swept range as already discussed. The two components form a critical damping network.

Close tolerances are specified for these components, but the 30 pf two p.c. may not be readily available except to special order. We made do with a 5 p.c., and this was quite satisfactory in our case. However, if trouble is experienced in this regard, this value should be checked. Note particularly, that this network must be connected to the end of the winding marked with a yellow dot.

Bias voltage for the control winding is taken from the HT line (approximately 150 volts) through a 50K variable resistor and a 15K limiting resistor. Optimum bias is essential for maximum sweep (approximately 10 Mc) but also may be used within narrow limits as a fine tuning control.

SWEEP VOLTAGE

Approximately 300 volts AC (RMS) is available from the power supply as a sweep voltage, and this is applied to the control winding through a 50K variable resistor which serves as a deviation control. Voltage from the same line is taken out to a panel terminal to provide the CRO sweep.

A necessary precaution in this part of the circuit is a filter to guard against any severe distortion of the 50 cps wave form which might occur for a number of reasons. These are undesirable because, although the beam of the CRO should follow them readily, the sweep unit may not respond in exactly the same manner. This could produce undesirable forms of non-linearity.

To avoid it, we supply both the CRO and the sweep unit through a simple filter network designed to suppress the majority of harmonics likely to be present in the mains. This consists of an 82K (2W) resistor in series with the line, and a .27 mfd capacitor by-passing it to chassis. In our case, this resistor was made up from a 33K and a 47K in series.

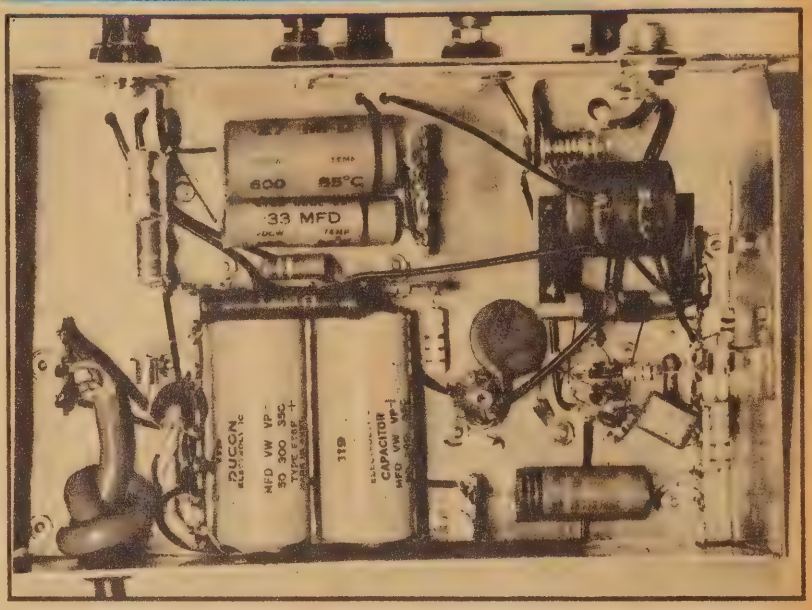
Also from the 300 volt supply we derive the retrace suppression voltage for the grids of the oscillator valves. This is fed through a .1 mfd capacitor and a 56K resistor in series to provide the necessary phase shift. A silicon diode rectifier (OA210 etc.) connected between this supply line and chassis prevents the application of a positive voltage to the grids.

R. F. PICKUP

The RF signal is picked up from the oscillator circuit by means of the small loop mounted between the two halves of the main winding. One end connects to chassis through a low value resistor and the other connects to a low value carbon pot. which serves as an attenuator.

The function of the resistor in the earthy side is to provide an injection point for the external marker generator. The value originally suggested for this component was 10 ohms but, in the rough model on which we made our initial experiments, this appeared to be too low, calling for an inconveniently high marker input to produce a visible marker in all parts of the pattern.

UNDERSIDE LAYOUT & WIRING



The power supply components may be seen at the lower left of this picture, with the sweep filter components above them. The oscillator section is on the right, with the sweep unit clearly visible. Most of the oscillator components are mounted on the tag strip at the extreme right.

Increasing the resistor to 47 ohms made a considerable improvement, although at the expense of some RF output. Subsequently, in our final model, it appeared that this value might possibly stand reducing slightly. This apparent inconsistency may be due to the use of a modified version of the VU/1 in the second model. In any case, there appears to be no reason why this value may not be varied between these values as required.

CARBON POT

The attenuator should, ideally, be a 500 ohm carbon pot., but this is not a very common value in the carbon types. The best we have been able to do is a 1,000 ohm version, and this appears to be quite satisfactory.

The power supply is a relatively simple set-up. It uses a standard 150V, 30mA power transformer, with half the winding supplying the DC HT through a silicon rectifier and simple filter network, and the full winding supplying the 300V AC for the sweep circuits.

The rectifier is a simple half-wave arrangement which, in conjunction with two 50 mfd electrolytics and a 1500 ohm resistor, is quite adequate to cope with the few mA required by the oscillator. However, to avoid frequency shift due to line voltage variations, it is desirable that this voltage should be held constant.

An OA2 voltage regulator valve, isolated from the last electrolytic by a 220 ohm resistor, performs this function, pegging the supply in the vicinity of 150 volts.

The construction of the unit should not present any serious difficulties. We built our unit in a standard small instrument case, on a standard blank chassis. However, a blueprint will be prepared showing the holes required, and a suitable ready-punched chassis should be available in the usual way.

It should be particularly noted that a steel chassis is not recommended, due to the possibility of the magnetic field from the power transformer coupling with the sweep unit in an unwanted manner. Aluminium chassis for these cases are standard items with at least one manufacturer.

A good idea of the layout can be obtained from the photographs. With a few exceptions this is not critical, but the arrangement shown seems to be as logical and convenient as any. Broadly speaking, the power supply occupies one half of the chassis, and the oscillator the other half.

POWER SUPPLY

The power transformer leads are terminated on an eight terminal tag strip, with one terminal clipped off to clear the rear of the chassis. It is held by two of the four transformer mounting bolts. It also accommodates the silicon rectifier and one of the electrolytics.

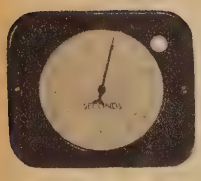
A seven terminal strip is mounted almost in line with the previous one, towards the front of the chassis. This may also need a terminal clipped off to clear the chassis. It supports the 82K resistor (two 1W types in series) and one end of the .27 and .33 mfd capacitors. A lead from it connects to the CRO deflection terminal on the panel.

Another eight terminal strip mounted at right angles to the first two supports the remainder of the power supply components, plus the 15K limiting resistor in the fine tune circuit.

Most of the oscillator components are

TIME

GENTLEMEN



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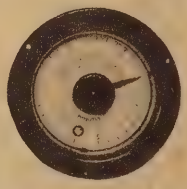

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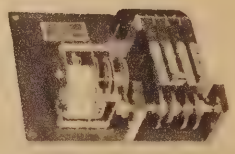

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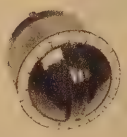

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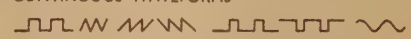

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either supported on the oscillator socket, or between the oscillator socket and the two tag strips running parallel with the side of the chassis. One is an eight terminal type and the other a two terminal type. The components directly on the socket are the two 6.8 pf grid plate coupling capacitors and the two 10K grid resistors. The VU/1 unit is supplied complete with its own supporting pillars.

The two insulated tag terminals nearest the front of the chassis are used to terminate the RF output leads from the pickup loop on the sweep unit. One of these returns to chassis via the marker input resistor and the other connects to the attenuator system.

In regard to the latter, it is worthwhile taking some care with earthing points to minimise chassis currents and possible leakage effects. To this end, the following points should be observed.

SHIELDED CABLE

The line from the tag strip to the attenuator and back to the output socket on the panel is composed of insulated coaxial cable, such as PT9M. For a job of this kind, the outer insulation is as important as shielding braid.

The braid is connected to chassis at one point only, this being a solder lug under one of the 12AU7 mounting bolts. It is most important that it be kept insulated from the chassis at all other points.

In particular, a chassis connection must be avoided at the RF output socket on the panel. This normally will be supplied with insulating washers and these should be used to ensure that the shielding braid connects only to the frame of the socket, but not to the front panel or chassis. Similarly, make sure that the earthy lug on the attenuator connects to the braid only, not to the metal pot. cover as well.

The above should cover the major constructional points and, if followed carefully, the finished instrument should function without difficulty. All that remains to be done is to see that it is covering the required band, both as regards the centre frequency and the amount of sweep.

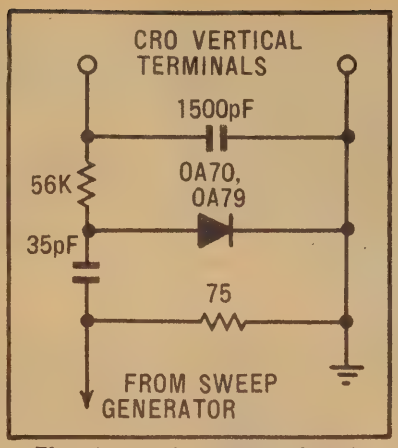
The easiest way to check any sweep generator is to feed the RF output to the vertical deflection terminals of a CRO, via a suitable demodulating network, the horizontal plates being fed with the sweep voltage from the generator.

RECTANGULAR PATTERN

This will produce a rectangular pattern consisting of a base line produced during the inactive retrace period with a horizontal line above it representing the demodulated product of the swept RF voltage. If the output of the generator is constant over the swept band, this line will be perfectly flat, and something very close to this should be achieved with this instrument.

If there are any serious variations in level, check the tolerances of the 30 pf capacitor and the 470 ohm resistor between one side of the oscillator coil and chassis. Check also that they are connected to the correct end of the oscillator coil.

The frequency coverage may be checked by feeding a marker signal into the generator which will produce a marker pip on the rectangular pattern. Ideally, the centre frequency should be at approximately 34 Mc, with a sweep of about 5 Mc each side of this point.



The circuit of a simple demodulator network which may be used to check the unit. It should produce a rectangular pattern on the CRO screen.

There should be no difficulty in setting the centre frequency to this figure, using the fine tuning control, but check that this setting (of the bias) is optimum in that it permits maximum or near maximum sweep. As a guide to what to expect it is handy to remember that, using vision and sound IFs of 36 and 30.5 Mc respectively, the adjacent channels, to which traps may have to be set, are 29 and 37.5 Mc.

FREQUENCY CONTROL

There are a number of factors which might influence the centre frequency in individual cases. One is the length of the leads from the oscillator coil to the valve socket, the original recommendation being that these be left uncut. However, our layout made shorter leads desirable and we seem to have avoided serious trouble, although the tendency is for the frequency to be a little on the high side.

Another factor is the presence of the centre shield in the 12AU7 socket. The orginal recommendation was that this be removed but, once again, we managed to avoid this without serious consequences. In fact, it may well be that we are bucking one of these factors against the other. However, these points are mentioned in case adjustment should be needed in individual cases.

A third factor is the tolerance of the 6.8 pf plate-grid coupling capacitors. Since this appears to be fairly critical the makers of the sweep unit have undertaken to supply a pair of these with each unit. On the other hand, there would appear to be no objection to deliberately varying this value slightly if other means of achieving exact coverage should prove inadequate.

In checking the frequency range it must be appreciated that there is a limit to the deviation which is possible without grossly distorting the swept frequency. The most obvious effect is to produce two marker pips at one end of the trace, travelling in opposite directions and meeting at some point in from the end.

This is quite normal when the deviation is pushed too far, but may be aggravated a little if the phase of the retrace suppression voltage is not optimum. It is, therefore, worthwhile to vary the value of the phase shift components slightly to reduce this effect to a minimum.

PERFORMANCE

The finished instrument appears to be an extremely useful and well behaved unit. It has an essentially level output, and behaved in this manner right from the start, without adjustments of any kind. Leakage appears to be very low, in spite of the simple shielding employed, and is perfectly adequate for practical purposes.

It covers the frequency range from adjacent channel to adjacent channel (8.5 Mc) with something to spare, while it should have sufficient fine tuning range to take care of the alternative IFs suggested by the Australian Broadcasting Control Board, or as used by some local manufacturers at the present time.

In short, if you want a simple generator at a moderate cost, but which will take care of the really difficult part of TV alignment, then this would seem to be the answer.

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BECAUSE of an unfortunate misunderstanding, the power transformer for the Unit Playmaster No. 1 amplifier was quoted as having a secondary rating of 140 approx. volts.

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MSP3.58

DISTORTION IN A-F AMPLIFIERS

This article explains, in simple terms, how distortion occurs in the output stages of audio amplifiers, and the nature of that distortion. Something is said also of noise and hum, which are frequently the cause of dissatisfaction.

By W. J. Sember*

THERE are two types of distortion encountered in audio work; Simple Harmonic and Intermodulation Distortion. Both of these have their cause in essentially the same source; a curvature of the amplifier transfer characteristics.

Although Audio Transformers and semi-conductors have similar non-linear characteristics which contribute to Intermodulation distortion, this discussion will be confined mainly to valve characteristics; the effects of improper operating conditions thereon; and the deterioration of performance caused by using valves beyond their useful life.

Simple Harmonic Distortion in a single-ended amplifier will be discussed first, since it provides a basis for the later subject of Intermodulation Distortion and Push-Pull Operation.

BASIC PRINCIPLES

Figure 1 shows the transfer characteristic of a single-ended power output valve. The operating point is shown and the AC plate current is drawn to indicate that the valve is operating with a small signal; hence, the grid voltage is sweeping only a small, relatively straight portion of the curve. In this case, the output wave reproduces the input waveshape almost exactly, and therefore the distortion is low.

Figure 2 shows what happens when this amplifier is driven to full output. The amplifier is biased halfway between zero bias and cutoff, and the signal drives the full distance between these points.

Since the transfer characteristic is non-linear, the output wave is not the exact duplicate of the input waveshape, and is said to be distorted. A stretching or peaking of the wave occurs near cutoff.

HARMONICS

If the input waveshape is sinusoidal, the output wave is no longer sinusoidal, but a complex waveform composed of a fundamental sine wave and additional sinusoidal components which are multiples of the fundamental frequency.

These frequencies, being multiples of the fundamental, are termed "harmonics," and are the products of distortion; hence, the "harmonic distortion" term. Only the second and third harmonics of the fundamental are of interest, since they are usually the largest in magnitude.

The second harmonic occurs due to distortion near cutoff, and the third harmonic is generated due to distortion near zero bias. The RMS sum of these harmonic voltages, expressed as a per cent of the voltage in the fundamental, is the Total Harmonic Distortion in an amplifier.

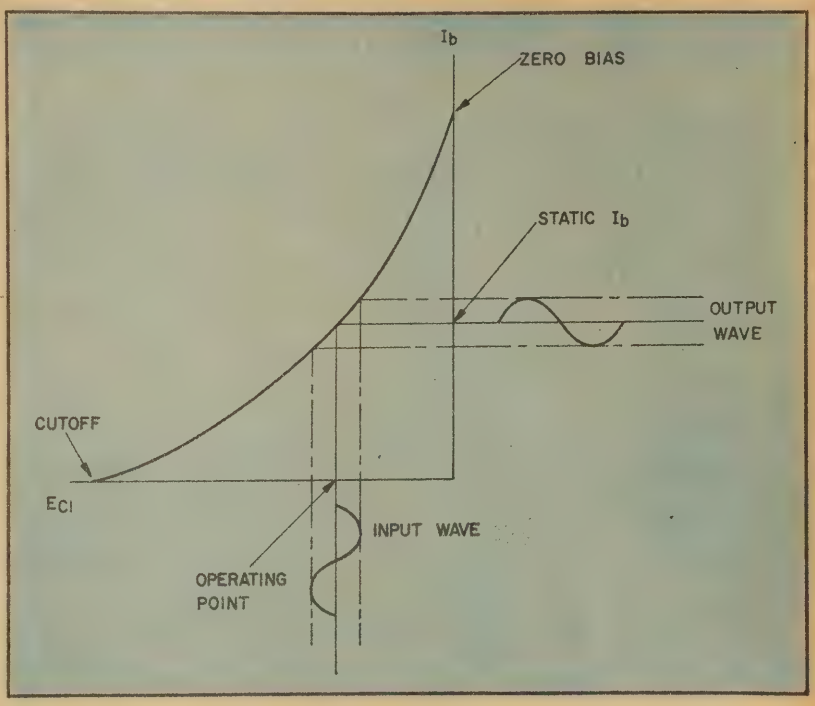

Figure 1. Transfer characteristic of a single-ended power output tube with small signal.

A balanced push-pull circuit may be similarly observed as shown in Figure 3. The overall transfer characteristic of the amplifier is shown in dotted lines. Due to the fact that the two tubes conduct alternately the overall transfer characteristic has no real cutoff point or curvature approaching cutoff; hence, there should be no second harmonic distortion component.

Since the overall transfer characteristic is relatively straight, the distortion over the entire operating range is also low.

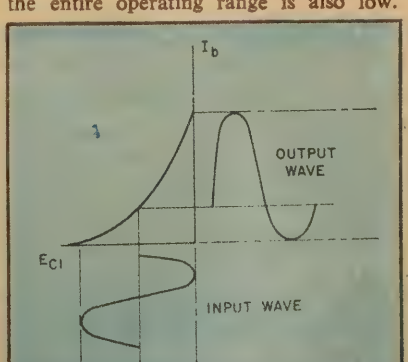

FIGURE 2—Transfer characteristic of a single-ended power output tube at maximum signal.

However, unbalanced push-pull tubes may have a second harmonic component, since their transfer characteristic may appear as shown in Figure 4. The curvature near the operating point will introduce considerable second harmonic distortion.

Intermodulation Distortion also has its origin in a curved transfer characteristic, whether in single-ended or push-pull operation. Although a non-linear characteristic is necessary for detection, it also produces modulation. This undesirable product may occur within an amplifier when more than one tone is being amplified at the same time.

INTERMODULATION

The distortion introduced in this manner is termed "Intermodulation Distortion," or I.M. It may be defined as the distortion products produced when one signal within an amplifier modulates another signal within an amplifier modulates another signal within the same amplifier. The I.M. is then the magnitude of the undesirable sidebands produced by this modulation.

For example, if two different test tones, such as 400 and 1,000 cycles are fed into an amplifier which has a non-linear transfer characteristic, 600 and 1,400, 200 and 1,800 cycle notes will be observed in the output, along with the original test tones.

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applied waves, but sidebands produced by the modulation of the 1,000 cycle note by the 400 cycle note. The R.M.S. sum of the voltages in these sidebands, expressed as a percentage of the voltage in the 1,000 cycle wave is then the per cent of Intermodulation Distortion.

Although there is no direct mathematical relationship between I.M. and Harmonic Distortion, the I.M. is generally the larger of the two at high power levels. The approximate relationship between the two for a pair of valves in push-pull operation is shown in Figure 5. The I.M. is slightly lower at low signal levels; but, as the power output increases, the I.M. climbs sharply, while harmonic distortion increases more gradually as the amplifier approaches rated power.

SINGLE ENDED & P.P.

Single-ended amplifiers have relatively high I.M., while push-pull amplifiers are capable of very low I.M. if the overall transfer characteristic is relatively straight. This is true because the single-ended amplifier must be content with its curved transfer characteristics, while push-pull tubes aid each other in producing a straight overall transfer characteristic.

Incidentally, in high quality audio work, where balance in the output tubes is adjustable, an I.M. meter is perhaps the best method of balancing the output. If balance is determined for minimum I.M., then the transfer characteristic is considered to be as straight as possible.

Intermodulation Distortion is difficult to measure with any real degree of accuracy or consistency. There are several valid ways of measuring it, and all give different results. One method, however, which has received wide acceptance, uses a test tone near the lower frequency limit of the amplifier, and a second test tone near the upper frequency limit.

The lower frequency tone is adjusted to be four times the magnitude of the upper frequency note; hence, the method is called the 4:1 Method of Measurement. Both tones are adjusted simultaneously to drive the amplifier to the desired power output, keeping the 4:1 ratio.

EXAMPLE

As an example, suppose 100 and 7,000 cycles are chosen as the two test tones. These are fed into the input of the amplifier such that the 100 cycle note is 4 times the R.M.S. value of the 7,000 cycle note. At the output of the amplifier, then, these test frequencies and their harmonics will be observed.

However, other frequencies, which are the products of the intermodulation between these two notes, will also be observed. In this case, the products of interest are those around the 7,000 cycle wave; 6,800, 6,900 and 7,100, 7,200 cycles.

The R.M.S. voltage sum of these intermodulation products, expressed as a percentage of the voltage in the 7,000 cycle wave, is the Intermodulation Distortion in the amplifier.

The second large area of complaint on some music systems is hum and/or noise. Hum is an extremely complex subject of which there are many aspects. There are three paths in the typical audio amplifier where hum might enter the signal path in sufficient quantity to be audible. These are: (1) The AC wiring within the chassis, (2) The DC power supply in the amplifier, and (3) the heaters of the valves, especially those in high gain stages.

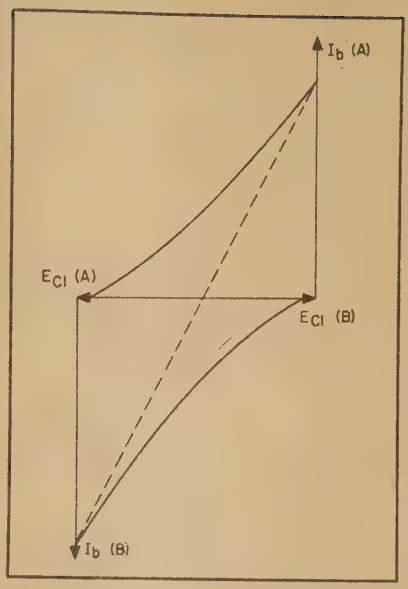

Figure 3. Transfer characteristic of a pair of balanced push-pull power output tubes, showing overall characteristics.

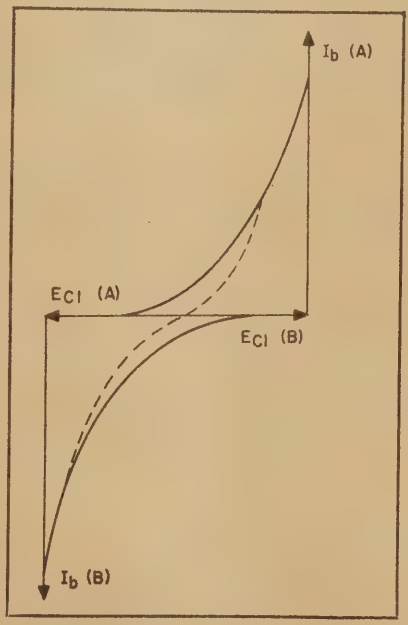

Figure 4. Transfer characteristic of a pair of unbalanced push-pull power output tubes.

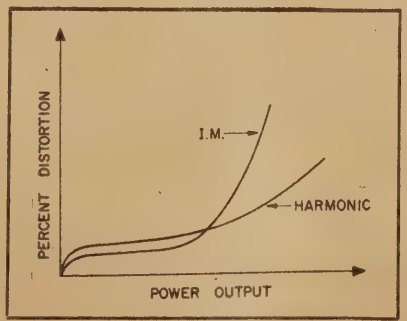

Figure 5. Comparison of I.M. and harmonic distortion in push-pull tubes.

Hum from an inadequately filtered DC supply is easily recognised if the amplifier employs a full-wave rectifier, since it will have a 100-cycle component.

Hum from the other two sources is difficult to segregate, since both have essentially a 50-cycle component, and hum from either or both of these sources may be entering the signal path at the same time.

In fact, an amplifier with low hum may be that way because hum is cancelling within the amplifier; that is, hum generated in the front end of an amplifier may be cancelled by out-of-phase hum voltage generated further along in the amplifier.

Thus, a "low-hum" valve in one application may be a high-hum valve in another application, which makes it difficult to predict whether a valve (although controlled in manufacture for exceptionally low hum) will exhibit low hum in every application; although, in most applications it will produce less hum.

Noise is taken to mean any extraneous sound other than hum. This includes hissing, snapping, or popping. A hissing noise may be caused by gas or leakage between the elements of tubes in high gain stages; or by resistors in these same stages producing thermal noise, especially if they are near a source of heat or are passing large DC currents.

This thermal noise from resistors produces a "rushing" or "hissing" in the speaker which is very similar to that produced by interelement leakage.

Snapping and popping noises are generally caused by thermal expansion of valve elements with warm-up. This type of noise can become quite objectionable during the first few minutes of operation of an amplifier.

Again, high gain stages should be suspected; and pentodes, because of their greater number of elements, are more prone to this type of noise than are triodes.

AIR MINISTRY ORDERS COLOUR TV

The British Ministry of Aviation has placed an order with E.M.I. Electronics Ltd., for what is believed to be the first permanent industrial colour TV installation in the United Kingdom.

A feature of the system, which will employ E.M.I.'s new compact three-vidicon colour camera, is that it can be controlled entirely from a remote position. An operator situated some distance from the camera can control its movements, focusing and selection of the required lens. A dust-tight housing will protect the camera during use.

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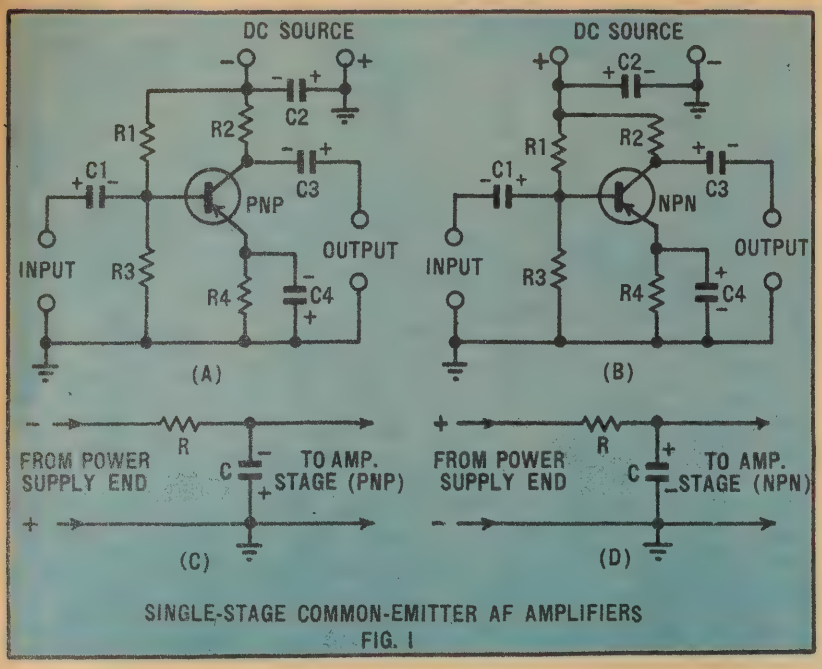
Only 30in long and weighing 160lb, the camera is cheaper and easier to operate than Image Orthicon cameras.

THE "C" IN TRANSISTOR CIRCUITS



SINGLE-STAGE COMMON-EMITTER AF AMPLIFIERS
FIG. 1

Transistorised equipment creates a large new application area for low-voltage capacitors. Since much of this equipment is miniaturised, it demands small-sized capacitors. The low impedance of the transistor necessitates much higher coupling and bypass capacitances, in many instances, than are employed in comparable valve circuits.

IN order to obtain these high capacitances in small packages, electrolytic capacitors therefore are employed in transistor circuits in positions where they are seldom found in valve circuits. This is particularly true of audio-frequency circuits.

In transistorised RF amplifiers and oscillators, and in flip-flops, multivibrators and other switching circuits, many of the capacitances are very nearly the same as those found in similar valve circuits.

Figure 1 shows single-stage, RC-coupled, common-emitter AF amplifiers circuits. This type of circuit is widely used in sound systems, instruments and control devices.

Figure 1 (A) employs a PNP transistor, and Figure 1 (B) an NPN transistor.

SINGLE FILTER

Figure 1 (C) and 1 (D) show a single decoupling filter, which would be required in a multistage amplifier consisting of several cascaded RC-coupled stages. Figure 1 (C) is used with the PNP circuit, and 1 (D) with the NPN circuit.

All capacitors are electrolytic. Note that the polarity of all capacitors must be reversed when the transistor is changed from PNP to NPN.

In Figures 1 (A) and 1 (B), C1 and C3 are coupling capacitors, whereas C2 and C4 are bypasses. DC base bias stabilisation is supplied by the voltage divider R1-R3, and current limiting by the emitter series resistor, R4.

The voltage division results in the application of a DC voltage somewhat lower than the supply voltage to the base of the transistor and to the inner terminal of C1. This voltage is negative in the PNP circuit and positive in the NPN. Unless degeneration is desired, R4 must be bypassed heavily by means of C4.

TYPICAL CONSTANTS

In a preamplifier employing a conventional AF transistor and a 6-12-volt supply, typical circuit constants are: C1 and C3 1 to 10 mfd (depending upon desired low-frequency response), C2 100-200 mfd, C4 50 mfd, R1 100K, R2 4.7K, R3 10K and R4 1K. In the decoupling filters (Figures 1C and 1D), typical values are C 50 mfd and R 220-330 ohms in a 3-stage voltage amplifier.

Capacitor C1 looks into a relatively low resistance, comprised by the internal base-emitter resistance of the transistor in parallel with bias resistor R3. This total resistance may be of the order of 1,000 ohms.

Hence, a high capacitance (1 to 10 mfd) is required in C1 to obtain the same low-frequency response and negligible phase shift afforded by a 0.1 mfd looking into a 0.5 megohm grid resistor in a comparable valve circuit.

When RC-coupled stages are cascaded, each output capacitor (C3) looks into the low base-emitter input resistance of the following stage. In a valve amplifier in which the coupling capacitance C=0.1 mfd and the grid resistance R= 0.5 megohm, the time constant t=50 milliseconds. To obtain the same value with the 1000-ohm input resistance of the transistor, C=t/R=50 mfd.

Even when the resistance of the AF signal source is low (as in the case of a reluctance pickup or dynamic microphone), Capacitor C1 is required to withstand only the steady DC voltage developed at the junction of R1 and R3.

LOWER POTENTIAL

Since this potential is much lower than the supply voltage, a capacitor rated at a continuous DC working voltage equal to the supply voltage will provide more than adequate safety factor.

Actually, a much lower DCVW rating may be tolerated here when miniaturization demands a smaller-sized (lower-voltage) capacitor, since in the circuits shown in Figures 1 (A) and 1 (B) the transistor base voltage is about one-tenth of the supply voltage.

The output coupling capacitor, C3, being connected directly to the collector of the transistor, must be rated to withstand continuously the DC supply voltage (less the drop across R2), plus the peak value of the collector signal voltage.

The DC voltage drop e developed across the emitter resistor, R4, is equal to IeR4 where Ie is the DC emitter current. Bypass capacitor C4 accordingly must be rated to withstand continuous voltage e plus the peak value of the AF signal voltage developed across R4.

The DCWV requirement of C4 generally will be less than one-half that o C3. For simplicity, however, capacitor of the same voltage rating often ar used in both positions.

DIFFERENT SITUATION

In a multistage circuit, the situatio is slightly different. The interstag coupling capacitor (C3 in Figure 2) ha the negative collector voltage of Trar sistor Q1 applied to its negative te minal, and the lower negative bias vo tage at the base of Transistor Q2 a plied to its positive terminal. (If NP transistors are used, all voltage an capacitor polarities are reversed.)

Capacitor C3 accordingly must b rated to withstand continuously the D supply voltage (less the drop across R3 plus the peak value of the Q1 collect signal voltage.

Capacitor C5 must be similarly rat with respect to the DC and AF collect voltages of Transistor Q2.

The DCWV ratings of bypass capa

tors C2 and C6, like C4 in the single-stage amplifier, are less than one-half those of C3 and C5; but, for simplicity, capacitors of the same rating often are used.

To prevent damage to coupling capacitors in circuits handling high signal-voltage levels, capacitors having sufficiently high DCWV ratings to ensure a good safety factor must be employed.

Since the total voltage applied to the capacitor is the sum of DC and signal voltages, the DC rating of the capacitor can be exceeded during the high signal-voltage peaks if the capacitor is selected only on the basis of the DC voltage expected in the circuit.

TWICE DC SUPPLY

For good safety factor, the supply by-pass capacitor (C2 in Figure 1 and C4 in Figure 2) should have a DCWV rating equal to twice the supply voltage. The filter capacitor in the decoupling network (C in Figures 1C and 1D) should be similarly rated.

The necessity that leakage currents be low in miniature electrolytic coupling capacitors in transistor circuits is apparent from an inspection of Figure 2. The voltage divider networks (R1-R2 and R5-R6) stabilise the DC base bias of the transistors.

This stabilisation provides some temperature compensation, as well as minimising changes in operation when transistors are interchanged or replaced.

Very importantly, the DC bias also sets the operating point of the transistor along its characteristic curve, so that Class-A operation, for example, is secured.

If the leakage of Capacitor C3 is high, the voltage at the junction of R5 and R6 will be raised to some value approaching the collector potential of Transistor Q1.

This change in voltage will shift the operating point of Transistor Q2, resulting in distortion, and will alter the stabilisation provided by the voltage divider. Additionally, the lowered impedance of C3 will alter the gain and phase shift characteristics of the amplifier.

High leakage in C3 will also reduce the DC collector voltage of Q1.

DC COMPONENT

High leakage in C5 will cause a DC component to be applied to the load device (or following amplifier stage) connected to the OUTPUT terminals.

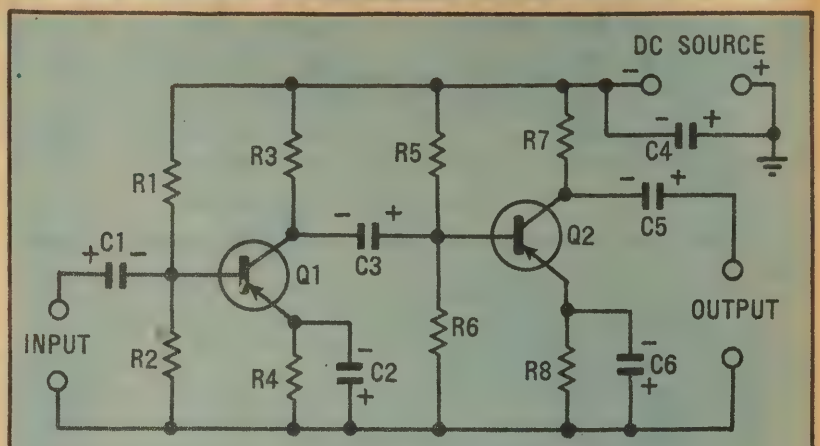
In short, DC leakage must be low enough that a coupling capacitor does not transmit a significant DC component and that a bypass capacitor does not materially reduce the DC resistance of the path in which it is included.

The RC coupled common-emitter circuit is at present the most widely used in transistorised AC signal circuits. Its general appeal is due to its high power gain, fair-to-good frequency response, and moderate input impedance.

Figure 3 shows additional circuit arrangements in which the correct polarity of electrolytic capacitors is indicated. NP transistors are shown. If NPN transistors are used, reverse all capacitor and voltage polarities.

Figure 3 (a) shows a common-base stage. The input resistance of the transistor is very low (50 ohms with some transistors). The input coupling capacitor, C1, therefore must be quite high in order to obtain the same frequency response, phase shift and gain supplied by comparable common-emitter and valve circuits.

TYPICAL TRANSISTOR CIRCUITS



C1, C3, C5-1-10mfd
C2, C6-50mfd
C4-100-200mfd

R1, R5-100K
R2, R6- 10K
R3, R7-5000
R4, R8-1000

2-STAGE COMMON-EMITTER AF AMPLIFIER

FIG. 2

Whereas an input coupling capacitance of 1 to 10 mfd (Figures 1 and 2) is suitable for the common-emitter circuit, C1 will be 10 to 50 mfd in the common-base circuit, depending upon type of transistor and desired low-frequency response. The capacitance of C3 will not be so high (generally 1 to 10 mfd) unless the load device has low resistance.

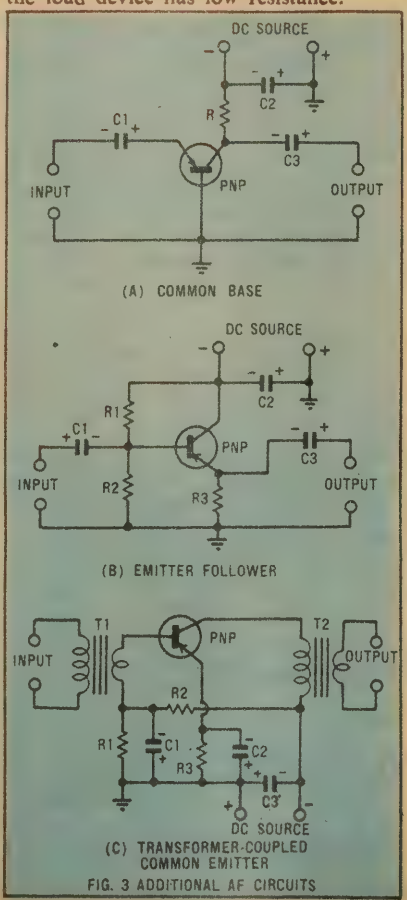


FIG. 3 ADDITIONAL AF CIRCUITS

Figure 3 (B) shows an emitter follower stage. This configuration provides high input impedance, low output impedance, wide frequency range, and no phase shift; and in these respects is similar to the cathode follower valve.

Here, Capacitors C1 and C2 have the same values specified earlier for the common-emitter circuit. Output coupling capacitor C3 is effectively in series with the low emitter resistance (R3) and the low resistance external load device.

This capacitance accordingly must be high and usually is of the order of 50 to 1000 mfd, depending upon the values of R3 and R1 (external load), and the desired low frequency response.

Figure 3 (C) shows a transformer coupled common-emitter stage in which the DC bias, developed by the R1-R2 voltage divider, is applied to the base of the transistor through the secondary winding of input transformer T1.

OFTEN USED

This arrangement often is used in power transistor stages, the bias network being placed in this position instead of across the input terminals (as in Figures 1 and 2) because the lower resistor would absorb some of the input signal.

Here, it is necessary to bypass heavily to prevent loss of signal voltage across the lower network resistor, R1. The bypass capacitance, C1, must be high, since R1 usually is low (commonly 100 to 1000 ohms). C1 will have a value between 50 and 500 mfd, depending upon the transistor type and R1 resistance.

Bypass capacitance C2 likewise must be high, since R3 (especially in power transistor stages) may be only a few ohms. This capacitance will be 100 to 1000 mfd, depending upon transistor type and R3 resistance.

The majority of capacitances employed in RF amplifier, oscillator, and oscillator circuits, including intermediate-frequency devices, extend from 5 mfd to 0.1 mfd.

This is true, also, of switching circuits, including flip-flops, multivibrators,

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6.3v at 3 amps
5.0v at 3 amps

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150 milliamps.
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These capacitances are obtained in miniature non-electrolytic capacitors, such as mica, ceramic, and (in the higher capacitances) metallised paper types. Therefore, there is no polarity problem.

These capacitors normally are rated to withstand much higher DC voltages than ordinarily are encountered in transistor circuits, consequently, voltage rating is no problem, either.

An occasional high capacitance, such as 10 mfd, is required for AVC infiltration or for DC supply bypassing, and a miniature electrolytic is employed in such instances.

Here, the rules discussed earlier apply to this capacitor. That is, the DCWV rating of the capacitor must exceed the sum of the supply voltage and signal-voltage peak, and the polarity is determined by whether the transistor is NPN or PNP.

A wide selection of miniature mica and ceramic capacitors is available for use in RF and switching circuits. The choice of a particular type will depend upon space requirements and, to some extent, upon whether conventional or printed-circuit construction is employed.

Because of their very high insulation resistance, non-electrolytic capacitors in transistor circuits present no leakage problems unless the capacitors are damaged.

The designer of new equipment in which capacitors are employed in frequency-determining circuits must pay particular attention to the magnitude and direction of the temperature-capacitance coefficient of ceramic capacitors to prevent undesired frequency shift from this source.

And the technician who replaces these capacitors in maintaining transistorised equipment must take special pains to use exact replacements.

(Reproduced by arrangement with the Aerovox Corporation)

THE SERVICEMAN WHO TELLS

(Continued from Page 51)

still working into that one you loaned me." (The 2-ohm job.) "I'm hoping it will be even better when I get mine going."

So there you are. So much for my theories about mismatched speakers and premature overload. It would appear that with the new output transformer the system was quite capable of delivering adequate power, without obvious distortion, even when grossly mismatched at least in this particular location.

The more I think of it, the more I feel convinced that the main trouble was in the output transformer. Maybe the system was mis-matched, and maybe that aggravated the trouble, but only because the transformer was not doing its job properly.

The most likely theory is that of insulation breakdown which shorted out one or more turns. Such a condition can wreck the performance of any amplifier in short order and if, in addition, the fault was intermittent, it could have been responsible for many of the inconsistencies we had noted.

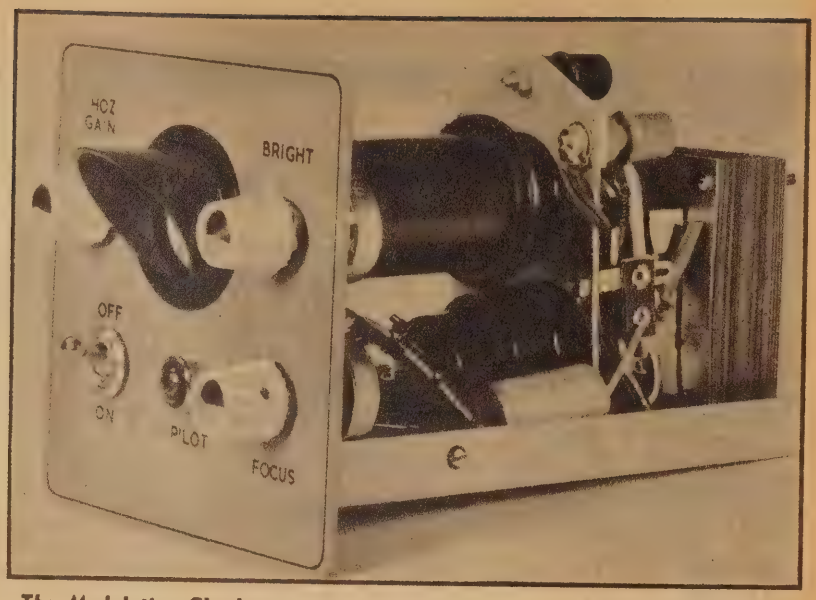
Fortunately, such a fault is almost certain to become worse in time, eventually bringing about complete failure as in this case.

But isn't it a nasty one?

A Simple Modulation Checker

Here is a neat and compact modulation monitor which can be built very cheaply and mounted in any vacant space in the amateur station rack.

By Brian Cleaves



The Modulation Checker is a neat and compact unit, making installation easy in any existing amateur station.

THERE comes a time in the career of every amateur using phone transmission, when a modulation monitor of some description has to be provided. This excludes the "monitor" at the other end who says, "Not quite enough modulation old man, turn 'er up a bit."

Basically, the modulation level should be set such that the accented syllables in normal speech—and only the accented syllables—modulate the carrier 100 per cent.

If the audio gain is advanced beyond this, overmodulation takes place and the downward swing of the envelope cuts off the RF output. Since the shape of the downward half of the modulating wave is no longer accurately reproduced, the modulation is distorted.

Distortion of the modulation envelope causes new frequencies to be generated being harmonics of the modulating frequency. These combine with the carrier to form new side frequencies that widen the channel occupied by the modulated signal. These suprious frequencies produce what is called "splatter."

SPLATTER

The end result of this effect is that the harmonics appear as side frequencies separated by many Kcs from the carrier frequency and capable of causing interference to adjacent channels. In addition, the signal may be distorted at the receiving station, though "splatter" and interference can occur before distortion becomes excessive.

The effect of under modulation is obvious enough. When conditions are poor and a good carrier with low modulation is received, the recovered audio in the receiver may, quite needlessly, be well down in the noise.

Quite apart from its ability to show over or under-modulation, a good indicator will show non-linear effects which will again result in distortion, with the generation of unnecessary harmonics. For example, and quite commonly, a modulating voltage sufficient to reduce the carrier to zero on negative peaks, may not double its amplitude on positive peaks. This results in so-called downward modulation.

Poor linearity is frequently caused by insufficient RF grid drive or the RF amplifier not being loaded properly to present the required impedance to the modulator. Or the trouble may be an unsuitable modulation transformer ratio.

Another cause, often overlooked, is poor H.T. regulation to the modulated stage. This often results when a common power supply is used for both transmitter and B class modulator.

There are several ways of checking modulation, each having its' own advantage and disadvantage.

One popular method is to insert a meter in series with the modulator plate supply and calibrate the meter so that a certain order of swing indicates full modulation. An oscilloscope is normally used to indicate when full modulation has been achieved.

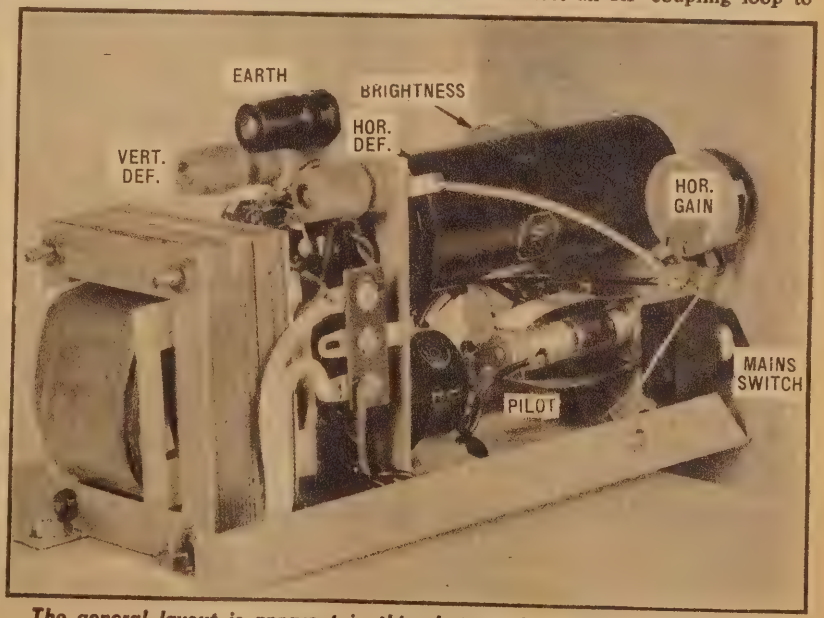
The method is only satisfactory with class B or class AB2 modulators, where the average plate current varies more or less in proportion to the audio power output.

It remains accurate only so long as the current conditions of the modulated amplifier remain unchanged and, in any case, it may not show instantaneous overmodulation peaks or the development of non-linearity, due to one cause or another.

CRO HAS ADVANTAGES

Whether or not an audio "output meter" is used, there is much to commend the idea of having an oscillographic type of moderation checker built into the transmitter. Not only is its presentation instantaneous and accurate but it does indicate the end result of the modulation process.

There are two ways of using an oscillograph for checking modulation. One well known way is to use the internal time base to provide horizontal deflection and to connect an RF coupling loop to



The general layout is apparent in this photograph, the unit being built on a tray measuring 6½in x 3in x ¼in sides. A 2in x 3¾in bracket supports the 913 and 6H6 valves.

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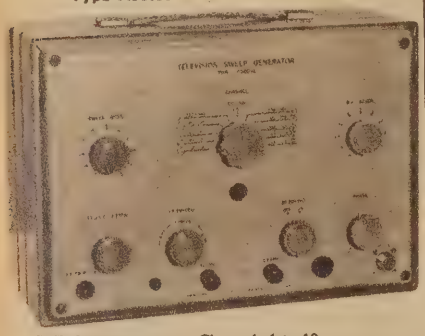

R.F. frequency range: Channels 1 to 10.
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Sweep width: 0 to 10 Mc/s.
Provision for oscilloscope time-base and phasing control.

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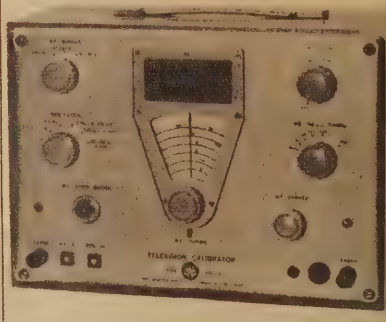

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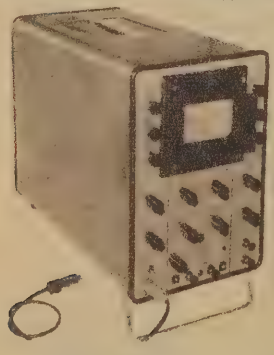

Frequency range: d.c. to 6 Mc/s.
Timebase: 1 usec/cm to 0.5 sec./cm.
Sensitivity: 100 mV p-p/cm.
Automatic triggering: 50 c/s to 2 Mc/s.
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the vertical plates. This provides a modulation envelope pattern on the oscillograph screen, which varies with speech input but which can be made stationary by the simple expedient of whistling a suitable "fixed" tone into the microphone.

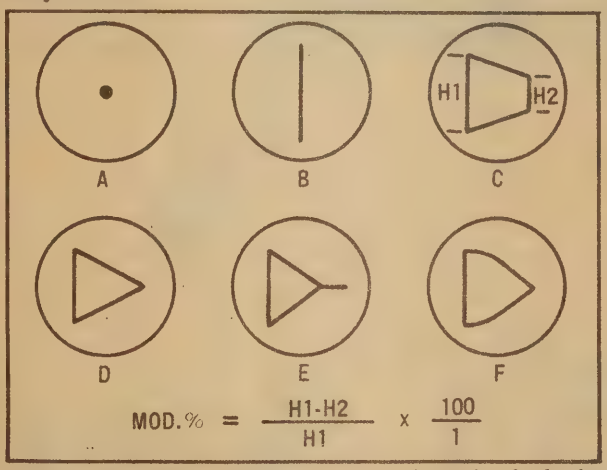
If you can provide a modulating tone by more "scientific" means, so much the better.

The second method is to feed a portion of the audio signal from the modulator to the horizontal plates in place of a time base. This produces a so-called "trapezoid" pattern and eliminates the need for a linear time base. It simplifies the unit considerably and is equally effective.

PROBLEMS

Using a standard oscilloscope as a modulation indicator presents several problems. Firstly its size makes a check something of a major operation. Secondly the C.R.O. must have provision for direct connectioin to the vertical deflection plates while, thirdly, phasing problems often result due to temporary connections made to the transmitter and modulator.

What is more, not every amateur has an oscilloscope so readily to hand.



(A) Spot produced by electron beam with no signal voltage applied to deflection plates. (B) A vertical line produced by an unmodulated carrier. (C) A trapezoidal pattern with 50% modulation. (D) A 100% modulated carrier. (E) An over modulated carrier. (F) Pattern with downward modulation.

In actual fact, a very small and inexpensive unit may be built and permanently fitted to any space in the station rack. Modulation may be checked instantly at a touch of a switch.

There is no reason why any type or size of cathode-ray tube may not be used for a built-in checker.

While the larger ones give a bigger and clearer pattern, higher voltages, and more space is required for their operation.

For our design we selected the smallest cathode-ray tube available. While the resolution is limited, the pattern still conveys the same information as the larger tubes.

However, we have learned, over the years, the necessity to exercise the utmost care, when using the smaller 1in type of tube, as it is very easy to burn the screen. For this reason, it is wise never to operate the tube without alternating voltages to the deflection plates.

In normal use the unit may be left switched on, but with the brightness turned right off. To check modulation at any time, it is only necessary to advance the brightness enough to inspect the pattern, after which it is turned back to cut off the electron beam.

There is no special point in having the pattern continuously visible, since it will only needlessly shorten the life of the screen. Added to this is the fact that the pattern would have to be switched off with the send-receive switch, otherwise a bright spot would be left on the screen.

From the circuit it will be seen that the design is based around the 913 CR tube, which is readily available on the disposal market. This tube will operate with very low voltages, making the power supply requirements very easy to satisfy.

POWER SUPPLY

The transformer selected for the job was a 150-0-150 volt unit. Using the full winding in a half-wave circuit, it produces approximately 400 volts DC, which is quite adequate for the 913.

The filtering required is small, because the current drain of the tube is low. A .1 mfd. 600v. capacitor gives adequate filtering for the half-wave circuit. The sensitivity of the tube is low also, making it largely immune to hum on the HT line and magnetic fields from neighbouring transformers.

A 6H6 disposal type rectifier is used, with the cathode at ground potential. This makes the chassis the positive side of the supply, keeping the deflection plates at chassis potential.

Official ratings of the 6H6 are exceeded with this arrangement, but past experience with 5-inch and 6-inch television sets indicates that the ratings are very conservative. In any case, the odd 6H6 which may break down can be replaced for 2/6.

A .0047 mfd. ceramic capacitor is connected between the control grid of the tube and chassis. This is to prevent the beam from being intensity modulated by the RF carrier. The rest of the circuit is quite straightforward.

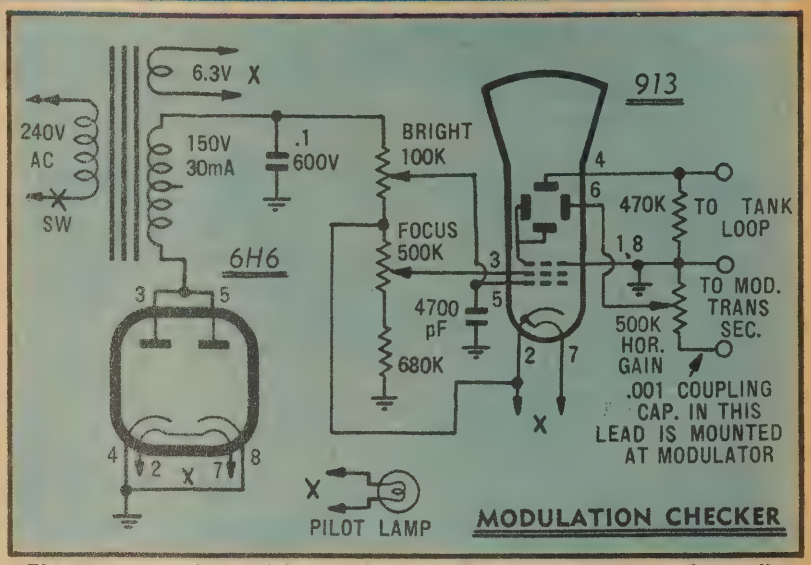
PHYSICAL DESIGN

Our unit was actually designed for mounting in the control unit chassis of the October, 1952, 35-watt transmitter. The mains lead was terminated to the mains supply of the control unit. The three terminals facing the rear of the unit allow easy disconnection for removal of the control unit from the rack.

The mechanical layout is not in any way critical and may be constructed to suit the requirements of any amateur. Our layout is neat and compact and was built to be installed in an existing station.

(Continued on Page 83)

MODULATION CHECKER CIRCUIT



The circuit of the modulation checker is quite straight forward in all respects.

Write for Catalogue of Prices

ROYCE DISC RECORDING EQUIPMENT

VIC. BOX 5041Y, G.P.O., MELBOURNE. FB2592
ROYCE RECORDING SUPPLIES, 291 EXHIBITION ST., MELB.
S. A. SCOTT SALES, 99 CURRIE ST., ADELAIDE, LA1201, ML4919.

IS EXPENSIVE STEREO WORTHWHILE?

We are often told expensive equipment is no good for the "ordinary" person.

Owners of 8 MX's tell us there is little to choose between them and 8in Wharfedales.

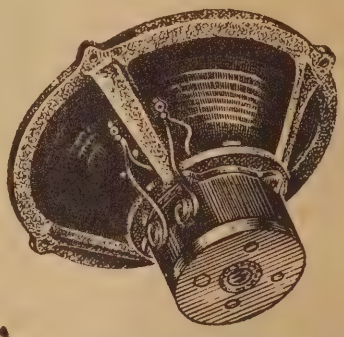
Owners of 10in Wharfedales assure us they sound the same as 12in Wharfedales and so on.

Unfortunately it is a hard world. The dearer equipment is better. It is not that twice as much money makes twice as good a sound: musical values cannot be assessed in this way.

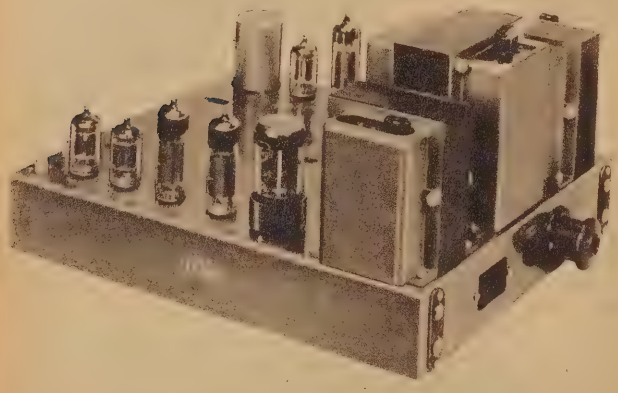
But for those to whom the finest is the only choice possible, we are proud to be able to demonstrate and supply the following equipment.

TANDBERG T/Recorder

ORTOFON



WHARFEDALE 12in.



LEAK STEREO 20 Power Amplifier

LEAK POINT ONE STEREO PRE-AMP

In the same range Decca, Fi-Cord, Ferrograph, etc., etc. For those whose pocket-books are not up to the standard of their dreams we carry a complete range of equipment and cabinets at prices to suit everyone.

Demonstrations can be arranged to suit your convenience, day, evenings and weekends.

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ENQUIRIES:—354 BRIDGE ROAD, RICHMOND—JB2820

(5 minutes from Flinders Street)

SHOWROOMS:—361 BRIDGE ROAD

With the aid of the photographs the unit would be easy to duplicate.

In mounting the modulation checker, the 4¼-inch square lettered plate is intended to mount in front of the transmitter or control unit panel, and the checker chassis behind it.

The shield over the tube face, mounted on the lettered plate, was made from an inch piece of 1in I.D. brass tube, soldered to a ring made from 18 S.W.G. brass sheet.

When coupling the unit to the transmitter, a .01 mfd. 1,000v. capacitor should be placed at the modulator, in series with the lead from the hot side of the modulation transformer secondary, to the horizontal terminal on the unit.

RF PICKUP

RF is provided from a loop of two or three turns coupled sufficiently to the tank coil to provide enough vertical deflection. This loop should be coupled to the checker via a twisted pair.

If the tank coil is inaccessible, the problem may be solved by using a parallel tuned circuit on the vertical plates, and tapping this coil near the earthy end. A length of wire may be connected to this tap to act as an aerial. The vertical deflection may be adjusted by moving the aerial or detuning the coil slightly.

The accompanying diagrams show the patterns which can be obtained with a modulation checker of this type and their significance.

FIGHTING RADIO INTEREFERENCE

THE annoying effects of radio interference on television and radio reception are well known and, in fact, have come to be accepted by many people as part of the price of viewing and listening. A more serious implication of interference, however, is the endangering of life through interruption to aircraft and shipping navigational aids and communication services, and to radio networks of essential community services such as ambulance, fire, electricity, etc.

Deciding acceptable limits, developing methods of measurement, and prescribing the necessary means of limiting radio interference are all problems under continuous investigation here and in other countries, and by international bodies.

In Australia, a committee was set up by the Standards Association to establish standards for the limits of radio interference. It is a widely representative committee, membership comprising the armed services, electrical manufacturers and supply authorities, broadcasting interests, C.S.I.R.O., I.R.E., O.T.C., and the postmaster-general's and other government departments.

Because, apart from atmospheric disturbances, interference can originate from a number of man-made sources, it was necessary to group these sources and then determine limits applicable to each group. The principal groups cover electrical appliances, TV receivers, and apparatus that generates radio frequency as part of its normal function.

The first work of the committee to be completed is a new Australian standard, C.321, Limits of Radio Interference for Electrical Applicances and Equipment. It applies to interference, in terms of noise voltage and noise field intensity, throughout the frequency range 0.4 to 300 Mc/s, and to electrical equipment, other than radio or TV receivers, in which the generation of radio frequency is not an inherent function.

The standard was prepared after consideration of similar overseas publications. It is closely related to the Canadian standard, where transmission and reception conditions are similar to those in this country. The permissible limits are prescribed in the specification, and appendices list typical equipment to which the standard applies and describe type testing procedures.

Copies of this standard, C.321, are available from the headquarters of the Standards Association in Sydney or from branch offices in capital cities and at Newcastle. The price is 6/.

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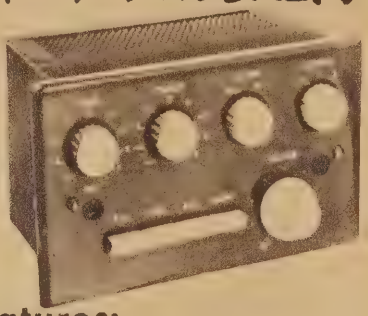
✳ NEW RELEASE!

THE NEW ROGERS MARK II HIGH FIDELITY STEREOPHONIC PRE-AMPLIFIER

only £48/0/0 | or £5 DEPOSIT 9/11 WEEKLY!



PUSH-BUTTON SELECTION

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FLAT OR R.I.A.A. INPUTS.

With these new features:

✳ Continuously variable low-pass filter 5 to 20 K.C.

✳ Guaged volume controls with separate balance control on Concentric Spindles.

✳ Improved tape and pick-up inputs.

✳ Built-in High Pass Filter.

This unit is suitable for converting crystal amplifiers to HiFi Magnetic Stereo.

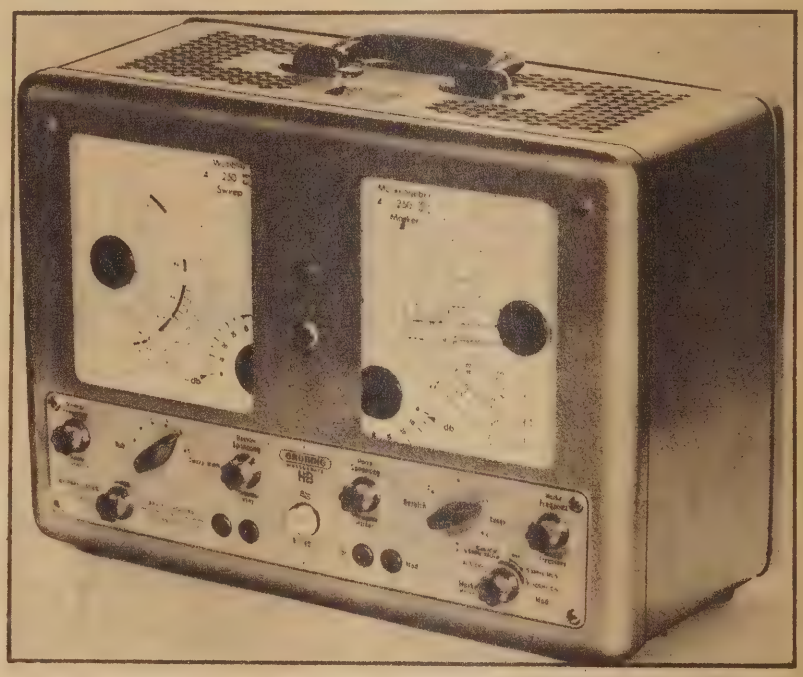
YES! TRADE-INS ACCEPTED!

Edels PTY. LTD. 88 KING ST. BL1551

TRADE REVIEWS AND RELEASES

HIGH PERFORMANCE SWEEP & MARKER GENERATOR

Organisations requiring a high quality sweep and marker generator, either for the service bench or the more exacting work of the laboratory will be interested in the Grundig model 6016, a sample of which was recently examined in our own workshop.



This picture shows the large clear dials for both the sweep and marker oscillators and the "db" calibrations for both attenuators. All sweep controls are on the left hand side and all marker controls on the right.

THIS model has all the features normally expected in an instrument of this kind, plus a few less frequently encountered. It has clear, easy-to-read dials, and a logical layout for the controls, while the finish of both the instrument itself and the accessories is of top quality.

The sweep generator covers from 4 Mc to 250 Mc in a single band, without the use of harmonics, while the width of the sweep may be varied from 1 Mc to 30 Mc in six convenient steps.

The marker generator covers the same range in six bands, all on fundamentals. The marker may be unmodulated, modulated with an internal 800 cps sine wave, modulated externally, or modulated with the self-contained 5.5 Mc crystal. This latter arrangement provides two extra marker pips which are always above and below the main marker by 5.5 Mc, and is a most useful feature.

CLEAR DIALS

Some idea of the dial layout can be obtained from the photographs, and these are large and easy to read. The attenuator dial for each section is included in the dial space. Commonly used frequencies, such as 5.5 and 10.7 Mc are clearly marked.

Both the sweep and marker attenuators are calibrated from "0" to "100" db, "0 db" representing full output. They appear to be particularly effective, it being impossible to detect any sign of leakage in either one. Absolute values for "0 db" are given in the instructional manual.

Finish is in grey hammertone, with grey plastic knobs and an attractive etched label. Accessories normally supplied consist of two output leads, one with balanced output (as for aerial connection) and the other unbalanced (as for IF connection), plus a special coupling shield for use over the converter valve.

This latter arrangement is quite ingenious. It consists of a complete outer shield to guard against unwanted pickup, plus a slightly smaller inner cylinder, insulated from the shield, which couples to the valve by stray capacitance. A suitable terminating resistor is built into the unit. However, where space may be restricted, a conventional "split shield" may still be used.

On test the unit performed extremely well, with every control doing precisely what it is supposed to do. The sweep is essentially linear over the centre portion of its range and is sufficiently wide to meet all requirements within this portion.

Summing up, we would say that this appears to be a first class instrument in every respect, and should satisfy the most exacting requiments of factory or service shop.

Our sample from the Australian agents, Jacoby Mitchell and Co. Pty. Ltd., 469 Kent Street, Sydney, from whom any further details may be obtained. Price is quoted as £187/15/ (Sydney) plus sales tax where applicable.

SCREWDRIVER/NEON INDICATOR

Electricians and radio workers frequently have need to determine whether a particular line is "alive" or safe to handle. Where a meter cannot be used, a simple screwdriver and neon indicator recently released by Philips Electrical Industries should prove invaluable.

THE unit is a handy pocket sized screwdriver fitted with a pocket clip and is a useful little tool in this respect alone. In addition, it is fittted with a small neon tube and is capable of indicating voltages from 110 to 380, AC or DC.

The neon is replaceable and the unit can be quickly and easily dismantled for this purpose. The body is moulded from clear polystyrene, with a red plastic top.

In use, the screwdriver blade is touched on the circuit to be tested, and one finger placed on the red cap at the opposite end. The body capacitance to earth is sufficient to complete the circuit, and the neon lamp will glow if the circuit has a sufficient potential with respect to earth. It should be particularly useful in picking the active and neutral wires in electrical installations.

Retail price is 12/6, and further details may be obtained from Philips Electrical Industries, 69 Clarence Street, Sydney.

FESTIVAL SALES MANAGER

FESTIVAL Records Pty. Ltd. announce that Mr Noel Brown, formerly Metropolitan Sales Supervisor, has now been appointed to the position of Sales Manager of the Company. Mr Brown will now be responsible for merchandising the Company's product on a national basis.

"IRISH" TAPE NOW AVAILABLE

Irish brand recording tape, well known in the U.S.A., is now available in Australia, R. W. Steane & Co. Pty. Ltd. having been appointed exclusive agents in this country.

FOUR grades have been announced which, between them, should satisfy the requirements of most tape users. All are available on 5in and 7in reels.

The Brown Band tape is a keenly priced tape intended for general purpose applications in the home, church, school, etc., where the main requirement is a good quality tape for use on medium priced tape recorders. It uses a 1.5 mil. cellulose acetate base and is available in 600 and 1,200ft lengths. Retail prices are 25/7 and 44/7 respectively.

The Green Band material also uses a 1.5 mil. acetate base, but is a higher quality tape for professional use. It complies with all BIA and NAB specifications and should be suitable for use with existing bias settings. Also in 600 and 1,200ft lengths, it is priced at 32/6 and 51/ retail.

Long Play 601 is similar to the Green Band type, but uses a 1 mil. Mylar polyester film base to combine long playing time with high strength and tear resistance. Available in 900 and 1,800ft lengths, the price is 47/1 and 69/ retail.

Double Play 724 is again a similar coating, but uses a .5 mil. Tensilised Mylar base to provide double the normal playing time for a given size reel. The tensile strength, given as 6lb, is claimed to be twice as high as that for conventional thin tapes. Available in 1200 and 2400ft reels, prices are 78/10 and 133/ retail.

Further details from R. W. Steane and Co. Pty. Ltd., 2a Montrose Street, Hawthorn East, Victoria, or 8 Cadow Street, Pymble, N.S.W.

NEW BRAMCO TRANSFORMERS

The general acceptance of silicon diode power rectifiers, and the voltage doubling circuits they make possible, has created a wide demand for new power transformers. To help meet this demand, the well known firm of Bramco have recently released four new voltage-doubler type transformers.

THESE are designed as types PTD-1, PTD-2, PTD-3, and PTD-4. Types PTD-1, 2, and 3 are potted in metal containers measuring 3¼in square and 4¼in high. They are equipped with solder lug terminations in the base. Type PTD-4 is a smaller, open type unit, measuring 3 1/8 x 2¼ x 2 5/8in and having mounting holes 3 5/8in apart.

Types 1, 2, and 3 have tapped primaries to accommodate 220, 240, and 260 volt supplies. Type PTD-4 is suitable for 240 volts only. All four units have three secondary tappings, spaced 10 volts apart, to assist in making each unit as versatile as possible. All have two 6.3 volt filament windings with appropriate ratings.

The type PTD-1 has secondary taps at 165-175-185 volts and is capable of delivering 465 volts at 200 mA in conjunction with a pair of OA-214 or similar diodes.

Types PTD-2 and 3 both have secondaries of 110-120-130 volts and will deliver 310 volts DC. Type PTD-2 is rated at 200 mA and PTD-3 at 125 mA. Both are intended for use with the OA-210 or similar diodes.

PTD-4 has a secondary tapped at 105-115-125 and will deliver 300 volts DC at 60mA. It also is intended for the OA-210 type diodes.

Also available from this company is an interesting technical bulletin (No. 8) giving a simple explanation of voltage doubling circuits and some of the factors which must be considered in the design of transformers and associated circuitry. This, and other bulletins which are issued regularly may be obtained gratis on application.

Further details, prices, etc., on Bramco components may be obtained from Watkin Wynne Pty. Ltd., 21 Falcon Street, Crow's Nest, N.S.W. For technical bulletins, write to Bramco Radio Components, 83 Nelson Street, Wallsend, N.S.W.

"SAKURA" TR4H TESTER

20,000 OHMS PER VOLT SENSITIVITY

Volts, ohms, M.amps. Size 5½in x 3½in x 1½in. 17 ranges AC and DC.

Post Free **£9/3/6** Trade Price

Including Sales Tax, Battery and Test Leads.

With leather carrying case to suit,

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MULTI METER TESTERS

AC-DC VOLTS — OHMS—M.AMPS. — CAPACITY — DECIBELS.

MODEL No.	SENSITIVITY AC	SENSITIVITY DC	RETAIL PRICE Incl. Tax £ s. d.	REDUCED TO YOUR COST £ s. d.
	Ohms per Volt			
180	10,000	20,000	19 2 6	12 15 0
MT6D	"	"	16 15 0	11 2 6
320	"	"	15 10 0	10 7 6
MG310	"	"	15 0 0	10 2 6
TP5S	"	"	11 5 0	7 10 0
M.D.	10,000	10,000	8 10 0	5 16 3
MTIAS	10,000	5,000	14 12 6	9 15 3
MT2A5	4,000	2,000	10 19 6	7 6 3
PD3	2,000	2,000	8 10 0	5 12 6
TP5	"	"	7 17 6	5 5 0
TP10	"	"	7 0 0	4 14 6
LC15	Condenser and Resistance Tester		25 17 6	17 5 0

For further particulars please write.

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MAKING A TRANSISTOR PORTABLE?

TRANSPORTA 4

Complete Kit of Parts for Transporta Four as Featured in October Radio and Hobbies, including Cabinet as used with the Transporta,

£16-17-6

Plus Postage.

LESS CABINET, £14/7/6.

Most parts used in the Transporta Four can be used for the Transporta Seven should a larger set be required at a later date.

NEW 6V RECORD PLAYER, £7/15/-

These new 4-speed Record Players are supplied with turnover crystal pick-up and sapphire needles, and are suitable for use with the above or any transistor radio.
Postage and packing extra.
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COMPLETE KIT OF PARTS for the TRANSPORTA SEVEN

£25/17/6 SET WIRED AND TESTED £2/10/- EXTRA

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POSTING AND PACKING EXTRA on transistors 4 or 7 sets. } N.S.W., 15/-. INTERSTATE, 22/-.

STEREO AND AUDIO LEVEL INDICATORS

Designed for checking balance in stereo amplifiers or checking output of stereo or monaural equipment. Can be used as output meter. Simple to use, connect across voice coils of speakers.

£3'18'6

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TAPE-RECORDER MOTORS

New Collaro Tape Recorder Motors, 240 volt, A.C. Adaptable for many uses.

37/6 Post extra.

CONDENSER SPECIALS

Boxes of 100 new ceramic, mica, paper and electrolytic condensers in values ranging from 50pf mica to 5 400v paper. Values include .0001, .00025, .00075, .02, .05, 1. Also 500 mfd/12v., 8 mfd/525v., 16 mfd/350v., electrolytics.

25/- per 100.
Post Extra: N.S.W., 2/6; Int., 3/6.

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(Standard resistor colour code supplied.)

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NEW METER RECTIFIERS

Westinghouse 1 mA rectifiers, 15/.

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8mfd 525v 2/9
16mfd 600V 5/9
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240v pri., sec. 260 x 260, 250mA. 6.3 v windings.

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(To heavy for post.)

80 M.A. TRANSFORMER

240v pri., sec. 285 x 285, two 6.3v fil. windings.

32/6
Post: N.S.W., 5/; Int., 8/6.

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60mA prim.: 240v with 230v tapping. Sec. 285. x 285 with 6.3v filament winding 60mA.

25/- Plus postage, N.S.W. 3/6, Int., 5/3.

NEW MIDGET POWER TRANS.

40mA prim., 250v. Sec. 225 x 225 with 6.3v Fil. Winding.

25/- 2/6 Postage, N.S.W., Interstate, 4/6.

30mA 240v Prim. 150 x. 150v. Sec. with 6.3 v Fil. Winding.

22/6 Postage: N.S.W., 2/6 Interstate, 3/6.

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Standard Mica Condensers, small current types .00003 and .005, including most wanted values.

10/- Postage 1/6. per 100.

CARBON RESISTORS

New carbon resistors, mixed values. Well-known make. 10/ per 100. Post free.

NEW POTENTIOMETERS

with SWITCH STANDARD SPINDLE	WITH SWITCH SHORT SPINDLE	LESS SWITCH STANDARD SPINDLE	LESS SWITCH SHORT SPINDLE
25,000 ohms	100,000 ohms.	100,000 ohms.	50,000 ohms.
100,000 ohms	500,000 ohms.	500,000 ohms.	100,000 ohms.
500,000 ohms	2/6 ea. 24/ doz.	500 ohms.	500,000 ohms.
4/6 ea. 42/ doz.		5,000 ohms.	1/9 ea. 16/ doz.
		3/6 ea. 33/- doz.	

25,000 ohm screwdriver adjustment, 1/9.
500,000 ohm pots can be supplied tapped at 40,000 if required, post extra.

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SPECIAL PURCHASES!

New 5 Valve Dual - Wave Radiogram Chassis

THESE NEW DUAL WAVE RADIOGRAM CHASSIS MADE BY LEADING MANUFACTURER ARE EQUIPPED WITH LATEST MINIATURE VALVES AND SUPPLIED WITH 12in ROLA SPEAKER.

£16/15/- F.O.R.

PACKING 10/- EXTRA

NEW 4 SPEED RECORD CHANGERS

THESE NEW 4 SPEED RECORD CHANGERS ARE EQUIPPED WITH HIGH FIDELITY CRYSTAL PICK-UP AND SAPPHIRE NEEDLES. CAN ALSO BE USED AS A MANUAL PLAYER.
SUITABLE FOR USE WITH ABOVE RADIOGRAM CHASSIS. F.O.R.

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DUAL CONCENTRIC SWITCH POTENTIOMETERS

500,000 ohms plus 10,000 ohms, also
500,000 ohms plus 1 megohm.
Long spindle.
10/-
POST FREE.

NEW 4in PER-MAG SPEAKERS

5T or 7T Trans.
25/-
Post and Packing, 3/6.

HIGH IMPEDENCE HEADPHONES NEW 27/6

Post 2/6.

STANDARD INTERMEDIATE FREQUENCY TRANSFORMERS

455Kc. 1¼in square cans. Slug tune.
4/9 post extra.

NEW 4-SPEED PLAYERS

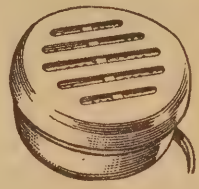
With turnover Crystal Pickup

£8 POST N.S.W. 7/6
INTERSTATE 12/-

NEW 4-SPEED STEREO PLAYER £12/10/-

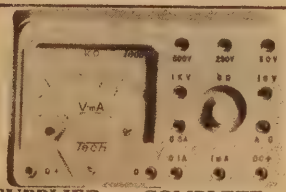
NEW STEREO CHANGER 4-SPEED, F.O.R. £17/10/-

PILLO-FONE EXTENSION UNIT



IT'S A REAL MINIATURE WITH ROLA UNIT

Install it anywhere, in the sick room, workshop, garage or any room in the house. Just connect across voice coil of the existing speaker. The "PILLO-FONE" IS THE MOST CONVENIENT LITTLE UNIT YET DEVISED.
3½in Diameter by 1¾in deep.
POST FREE. **22/6**



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METER 0-1mA 1000 OHMS PER VOLT

A.C. RANGES	D.C. RANGES	CURRENT RANGES
0—10v	0—10v	0—1MA
0—50v	0—50v	0—100MA
0—250v	0—250v	0—500MA
0—500v	0—500v	
0—1000v	0—1000v	

OHMS RANGE 0-100,000 OHMS.

NEW 12in PER MAG SPEAKERS

These Standard Speakers by leading manufacturer (we cannot advertise the make) are supplied less transformer.
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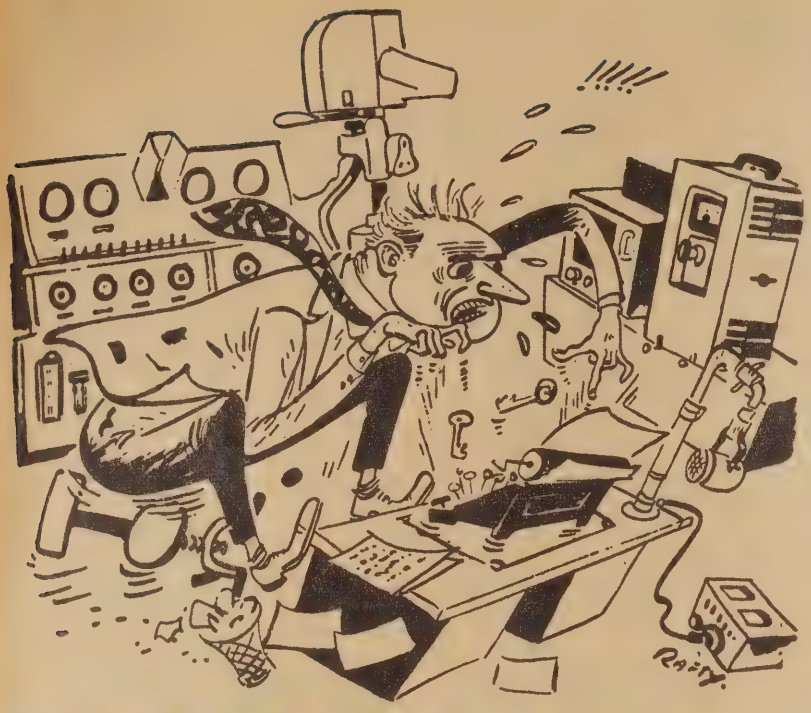

Let's Buy An Argument

I seem to have so many letters on hand at the moment that I have little choice but to curtail my own ramblings and fill the available space with correspondence. If I do otherwise, I stand to be accused of hogging the space and ignoring the opinions of others.

FIRST on the list is a letter from a reader in Concord, N.S.W., who, quite obviously, has very strong feelings on the subject of things American. He says, and I quote:

"Dear Sir,

"The principle proclaimed by R.D., of Ryde, whose letter was quoted in 'Let's Buy An Argument' (January, 1960), has my hearty goodwill and support. R.D. also has my sympathy over 'program.' I was taken in the same snare not long ago.

"In fact, there are traps associated even with such seemingly obvious cases as 'tire,' 'check,' 'pajamas' and 'galoshes,' as well as with a good many others; but as R., T.V. and H. is not a literary journal, I will not enlarge further.

"But R.D.'s pet hates are mine also. In addition, I particularly abominate the American rubbish poured out, day and night, by commercial broadcasting stations in their 'hit parades,' accompanied by the fatuous comments of 'Disc-Jockeys' with their imitation Americanese speech and carefully assumed Americanese accents.

"R.D. and I may be mere voices crying in the wilderness, but not all Neville Williams' guffaws and chuckles will make us believe that anything labelled 'American' needs no other recommendation."

Well, what do you know about that? Suddenly, and without any intention of so doing, I have become the champion of all things American, affirming, with the aid of guffaws and chuckles, that things labelled American need no other recommendation.

All because I used the word "Program" on the label of our "Program Source," instead of the spelling "Programme."

But such are our correspondent's feelings that he has chosen to ignore the subsequent revelation that "Program" is the original English spelling, and that "Programme" is French in its derivation.

by *Neville Williams*

As to the other words mentioned, they are not the subject of discussion.

However, our correspondent ends up on a very pleasant note, and again I quote:

"By way of letting down my blood-pressure, permit me to add a word in praise of 'Serviceman Who Tells.' My entire knowledge of electronics is just enough to enable me to twiddle the knobs on a radiogram, so that practically all of his technicalities might as well be written in Sanskrit for all I can make out of them.

"But his beautifully easy, conversational style, his wonderfully detailed accounts of tracking down this, that or the other elusive fault with probes, tests and meters, and his racy comments by the way on men, manners and affairs in general, make every one of his articles a delight to read, and as interesting and enthralling as a top-notch detective thriller. More power to him!

—Yours, &c., A.L."

Well, at least that should make the "Serviceman" happy. Come to think of it, that man gets a lot of bouquets in our mail.

He must have something!

But then, I'm not entirely unhappy, either, because the very next letter is also about the word "program" and expresses the alternative point of view. The writer says:

"Dear Editor,

"You are quite right. 'Program' is the correct form in English and is pronounced the same way throughout the country.

"The word found its way by mass migration of British settlers to America and many so-called American words are English words, pronounced as they were a century ago or more.

"As such, the American pronunciation is often the more correct and it is the English pronunciation which has changed.

"Yours faithfully, W.N."

Well, that's what W.N. says, anyway.

Mighty sweeping statements there, boy, but you made them!

Now, turning from mere words to more technical matters, I have to hand a letter from a New Zealand reader, who makes comment on the general subject of tape versus disc distortion. His letter is prompted by an opinion passed on to the late editor by one of the world's top recording engineers.

It was to the effect that the limit of ultimate audio quality is being set, at the moment, more by the tape medium than by the whole of the discing process.

On this subject our reader from New Zealand writes as follows:

"Dear Sir,

"I was surprised in reading your 'Off the Record' column (Feb., 1960), to see your figures for the relative distortion of tape and disc recording. My surprise, however, is not at the figures but the fact that they do not appear to be very well known.

"For some years one of my jobs, when I was in broadcasting, was to take monthly figures on all tape and disc recorders at our station, all professional 'studio' machines.

"The figure of 2% for tape recorders would appear to be about right, although up to about 2.5% would not be out of the way. This figure includes noise, since the conventional distortion and noise meter includes this in the total. Some machines, in fact, measure their signal-noise ratio in dB below the 3% distortion point.

"Contrast this with the figure from the disc recorders. On playback the figure was below 1.5% and, in the case of the most modern one usually less than 1%. This figure included not only noise flutter and rumble on recording and replay turntables, but the distortion in the pickup and seven valve stages and five transformers.

"Despite these figures, however, the tape replay usually sounds better than the disc, the reason being that electro mechanical systems always suffer from reduced transient response due to the inertia of the transducers although, in the case of the best and most modern of disc systems, the degradation of the signal is obviously very small.

"I must emphasise that these figures were obtained some years ago and I am dredging them out of my memory, so that I may be a few points out. However, as far as figures were concerned the discs were the better."

So runs the comment from our correspondent, V.M.S.

May I hasten to add that all this is not aimed at fostering a simple tape-versus-disc argument, though it started that way when one of our correspondents lamented our failure to give prerecorded tapes greater prominence.

Our attitude now, as then, is that we have no special prejudice one way or the other. Both systems are capable of giving fine results but their relative popularity is more a matter of merchandising, sales appeal and so on.

And while the vast majority show a practical preference for the disc system —and want to read about discs—that's where the emphasis must lie.

What has appeared in these columns recently has been aimed, really, at correcting the tacit but not necessarily valid assumption that tape is capable of better results than disc.

In point of fact, the results using either medium vary enormously with the equipment involved but very often, the advantage is with the disc.

As a further point of fact, both mediums are normally involved before the music finally emerges into our

PROOF OF THE STEREO PUDDING

Dear Sir,

From time to time, and particularly in the March issue, there have been articles and letters on the technical aspect of a third speaker in a stereo system. Attempts are made, on paper, to show why a third speaker would be out of phase, won't work or only work with distortion, etc. Well, I can't claim to be a technical man.

I have only been interested in and building high quality audio systems for my home use over the past ten or twelve years and I have worked on the principle of . . . "The proof of the pudding." . . . I had a three-speaker mono, Wharfedales and Kelly system, prior to the event of stereo and, while stereo became a must, if the best reproduction was to be enjoyed, I was not prepared to abandon the benefits of frequency division just for stereo effects. In other words, stereo effects from a couple of 8in speakers, column or otherwise, were just not good enough compared with mono woofer, squawker and tweeter results.

However, to duplicate my 9 c. ft. infinite baffle in my loungeroom was also "just not good enough" for my wife (or myself for that matter), so a compromise was necessary. I worked from the article by Mr Ritter, of Adelaide, and made up a large network with crossover at 250 cycles and fed the bass speaker with L. and R. signals from this.

Then I made two column-type enclosures and fitted each with two high performance 8in speakers. These are mounted on castors and can be placed at optimum positions on each side of the bass enclosure and they take the right and left channels respectively from 250 cycles upwards.

Then I channelled BOTH channels through a pair of 2mf capacitors to a Kelly ribbon tweeter which is mounted in the face of the centre woofer enclosure.

I can just imagine the looks of disgust and horror on your technical correspondents' faces, but the simple fact is that it works and works splendidly. I have all the advantages of my previous three-speaker system plus stereo and a number of musical friends have been good enough to give it the O.K. also. The stereo effect is quite marked.

For example, I played over the "My Fair Lady" record recommended by R. Tush a while ago and Pickering on the right and Liza on the left had quite a time.

Also, when Liza sang the song, "I Could Have Danced All Night" she distinctly danced around the room in front of me while doing so. Orchestral music spreads itself realistically right across the room and mono solo records centre right in front of the bass enclosure, so what more could you wish for of stereo.

Incidentally, the bass does not seem to be positioned at all. I keep the bass enclosure ACROSS THE CORNER, facing diagonally into the room and the "lows" appear to be quite non-directional.

I suppose, should you be kind enough to publish this letter, I can expect to be told by our technical friends that I am not hearing what I AM hearing.

Yours faithfully, C.W.W.

★ ★ ★

Dear Sir,

Here is another method of extending Stereo over a large listening area which offers several variations to suit particular conditions.

We know the care taken in design to ensure a high degree of separation and it is desirable that this separation be completely maintained to avoid pseudo effects.

Another quite common but undesirable tendency is to acquire a stereo-amplifier greatly exceeding in output the limits of the listening area and to literally blast the dead-spots with decibels until the listener's ear becomes saturated.

The listening area in the average Australian home could no doubt be satisfactorily served with about 2 watts output per channel, thus leaving sufficient surplus in £.s.d. for either a single-ended or double (stereo) amplifier with preamplification for microphone (s) to operate in the dead-spot.

Yes, I am suggesting three, four, or even more channels in special circumstances, of which only two operate the stereo channels, but all operate at low outputs. Total expenditure is not out of proportion, including one or more microphones, cabinets, etc.

In positioning, say, a four-channel group, a monaural track would be played on Stereo Channel A, with volume turned well down, and the microphone from channel B advanced toward speaker A.

The gain on Channel B will have to be set fairly well up, and when this channel reaches the threshold of "audibility" back the microphone off a little and slightly reduce the volume. Repeat for Channels C and D with A and B silent.

If positions and settings are correct, the whole unit will assume stereo balance, and final adjustments of balance and volume on the "stereo-channel" amplifier will control the whole unit, the secondary amplifiers acting as "slaves."

From the point of view of layout, the above unit would consist of a central radiogram housing both amplifiers as well as speakers B and C. Stereo tracks would be at speakers A and D in enclosures on either side of the central unit.

Yours faithfully, J.K.

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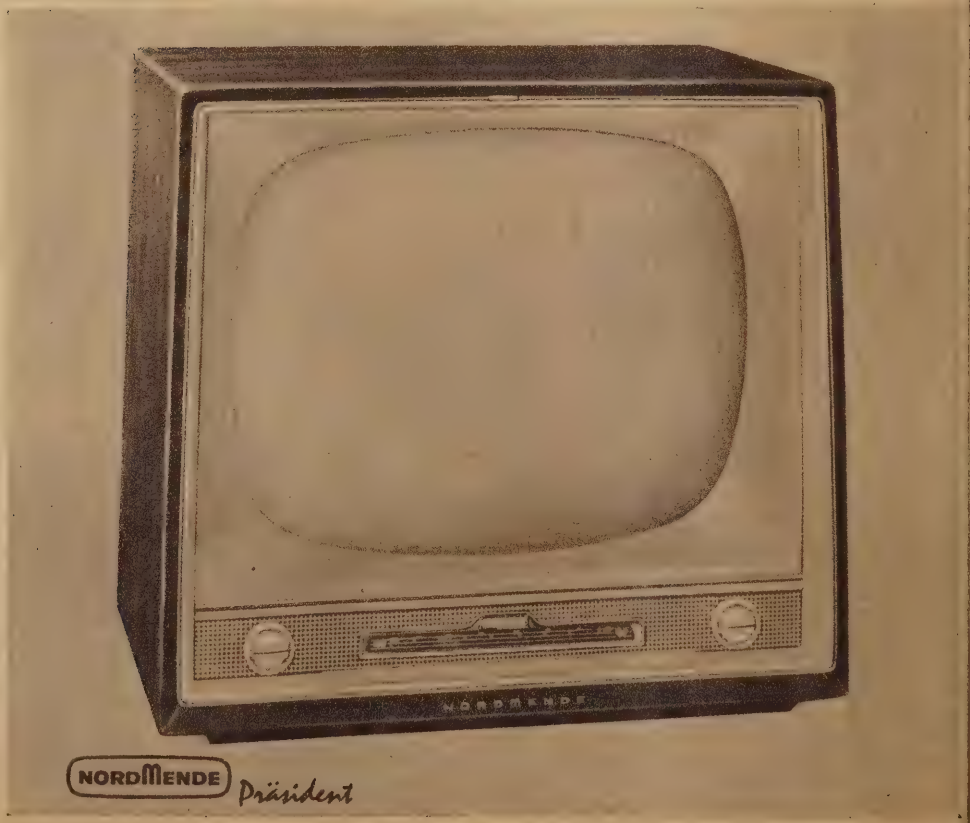

lounge room. The original material is taken on tape, then selected, edited and dubbed on to disc. As far as the end result is concerned, we have a stake in seeing both mediums developed to the highest possible degree.

In practice, neither is above reproach and the end result is compromised, sometimes by one, sometimes by the other. So much for that.

Changing the subject, our correspondent has some remarks to make about stereo reproduction and "hole in the middle" effects. I quote:

"I was also interested in your remarks about the 'hole in the middle effect' in stereo, and like yourself I have never noticed it except in the case of 'gimmicked' discs. By that, I mean records made in such a way that the program coming from the individual channels is completely separated much as though the mikes were in separate studios.

"One such disc had such a degree of separation that if you turned off one channel the instruments coming from it could not be heard at all in the other channel! In other words, the hole in the middle could be heard because that was the way it had been recorded.

"It was, incidentally, an American master, and to date I have not heard the effect off any European discs.

"I also note that hum with stereo playback seems in many cases to be troublesome. I am sure, however, that this will in many cases be cured when better pickups become available. In my case, I am using a Swedish B. & O. Stereodyne II, and find it completely without hum, even with full bass boost on. There are a number of these pickups now in use in N.Z., and most owners seem to have had similar results.

"Yours faithfully, V.M.S."

As you will observe from the accompanying panel, V.M.S. is not the only one with ideas on stereo and "hole in the middle" effects. But more of that anon.

In the meantime, I am inclined to think that a good deal of the argument about "holes in the middle" of a twin speaker stereo system is akin to arguing whether roses are or are not red.

Some are perfectly sure of the fact and, what's more, they can bring along red roses to prove it. Others are equally sure they are white or yellow or only partly red (i.e., pink).

But you and I know different.

It's a bit that way with stereo. Unless one handles a lot of discs, taken more or less at random, there is a tendency to base judgment of all on those which one happens to own or have access to. And they may well be discs of a class.

In actual fact, there is no uniformity in the method of using the stereo channels, any more than there is uniformity in the material to be recorded.

Choirs, orchestras and large instrumental groups are likely, and, of necessity, to be recorded to give a "spread out" effect.

With smaller groups and with vocalists, greater flexibility is possible and is exploited. Sometimes an even spread is sought. Sometimes the instruments are deliberately divided, or the soloist monopolises one channel, while the accompaniment emerges from the other. Yet again, the accompaniment can be split up, while the soloist occupies centre stage.

As V.M.S. points out, there may be a hole in the middle for the very simple reason that the artists and the recording engineers put it there! Whether the right thing would be to fill it in artificially becomes a matter of opinion.

Then again, I am quite certain that there is a great deal of self-delusion arising from the fact that, while ever we can see two speakers, our eyes dictate that we should hear them.

The ideal would undoubtedly be to have the speakers disguised, but this is seldom possible.

Closing the eyes sometimes works, but only after the visual memory of the speakers and room directions have faded.

But try standing a dummy speaker between the stereo pair. There'll be plenty of times you'll be prepared to swear that the dummy speaker is working; that someone has connected wires to it while you weren't looking!

The two letters in the panel on the earlier page make rather unusual reading, or at least one of them does.

The letter from C.W.W. makes sense from the conventional viewpoint, except for his commoning of the extreme high frequencies.

There could be room here for several ifs and buts, which could influence the conclusions to be drawn from his observations.

For example, over what range does the tweeter operate and how much energy emerges from it? It could be that there is not consistently enough output from the common tweeter to override the separation provided by the middle speakers.

Again, what degree of dispersion and reflection takes place in the room with the highest frequencies? Free dispersion and reflection may help camouflage their source.

And then, what degree of cross-coupling between channels does the link to the common tweeter introduce? The "isolating" capacitors may, in fact, be introducing a degree of coupling between the middle speakers and deteriorating the end result.

And finally, what are our correspondent's standards of performance in regard to stereo? Is he accepting what another might reject?

In other words, it isn't just a simple

(Continued on Page 95)

STEREO—LIGHT WAVES—COLOR

Dear Sir,

I would like to have something to say on the series of arguments you have been having lately about stereo, the need for a third speaker and also the origin of the stereo effect.

I would think that under normal everyday conditions our ears detect sound direction mainly by phase difference, with a partial dependence on loudness differences.

When listening to a stereo recording through the normal twin speaker set up though, the conditions are entirely different. Here the right ear can hear the sound from the right-hand speaker, and also that from the left speaker, and vice-versa, so that after careful separation of the channels all through the system, we allow them to mix freely in the air at the end.

The ear then gets phase differences introduced in the original recording and other differences due to the intermixing of the sound from the two sources. Under these conditions the ear would have difficulty detecting direction purely from this, so must depend on loudness differences.

Near-perfect stereo could only be gained by using headphones to feed the separate channels to each ear; then the phase difference would combine with the loudness difference to give the direction of the sound.

I would also like to comment on the argument of light waves, "Train or Matter" (Feb., 1960). As in all progressive wave motions, there are two factors concerning the wave velocity and the velocity of transmission.

In free space, the wave velocity is the same for all wave-lengths and the velocity of transmission of energy is the wave velocity.

In any other medium the wave velocity remains constant, while the velocity of transmission of energy is slowed, according to the refractive index of the medium.

The measured velocity of light is actually the group velocity of a "packet of waves" formed when a large number of different, but close wave-lengths interfere. This formation of pulses of light gives it the corpuscular characteristic which lead to light being regarded as particles.

There is another bit regarding light that I thought you may be interested in. Quite a few members of the Chemistry Department and the Physics Department here have been interested in a colour wheel, reproduced below.

When spun, the black sections appear to take on different colours, according to the direction of rotation. So far there has been no

satisfactory explanation, although the Psychology Department is carrying out research on it at present.

We found that a card made up as the one below, and with a pin through the centre, gave quite clear rings of colour if given a spin, and allowed to slow down.

Yours sincerely, A.T.T.,
(University of New England, Armidale).

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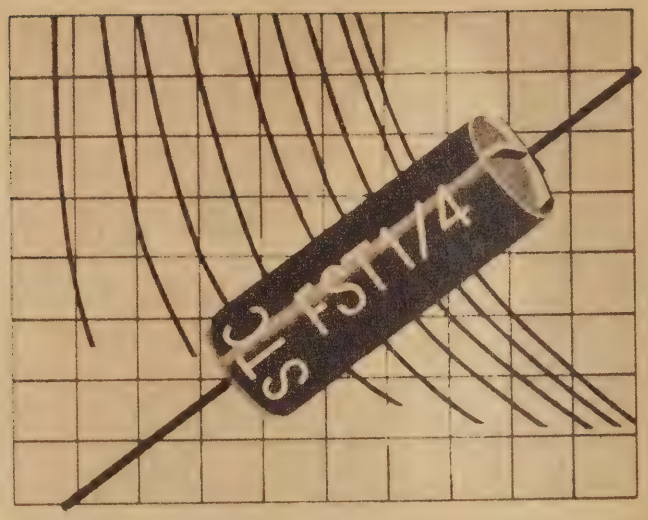

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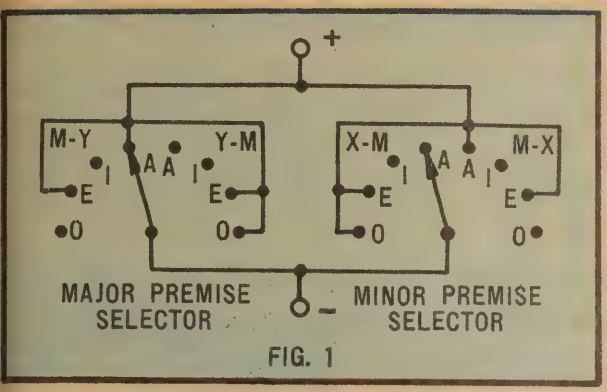

FIG. 1

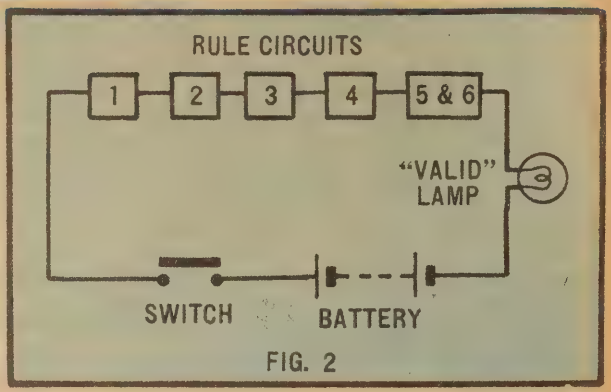

FIG. 2

Inspired by our recent series of articles on an electrically operated Aristotelian logic machine, written by Vol Molesworth, M.A., this article* by an electrical engineering student at Melbourne University describes a device which will test any syllogism for fallacies, and immediately indicate the exact nature of the fallacy, if one is found.

THE logic machines which have been described in the February and March issues of this magazine operate according to the principles of Aristotelian logic.

If the premises set up by the operator do not produce a logical conclusion, the machine quite properly produces no answer.

This has been described as the "dead end, chum," or "don't be silly" function.

However, it is instructive to build a machine which looks for fallacies and lets the operator know what they are.

In fact, demonstrations of such a fallacy finding device have caused considerable comment in the mathematics and philosophy departments of Melbourne University.

Since the general outline of Aristotelian logic has been given in earlier issues, we can confine ourselves here to the design and construction of a "foolproof fallacy finder."

The device proved quite inexpensive to build. The total cost of the prototype, using disposals parts, was about £2.

The use of relays in the earlier articles provides much fascination, but also adds to the cost.

To keep the cost down, it was decided to build the fallacy finder purely from switches, rather than to use a sequential circuit involving relays.

THREE WAFER SWITCHES

It was provided with three wafer switches, one for each premise (to be set on the desired proposition) and one to be set on the expected conclusion. A lamp, battery and push-button switch in series with the circuits were used to indicate whether or not the syllogism set up was valid.

Alternatively, two premises could be set up, the push-button held down, and the conclusion switch rotated to find a valid conclusion, or one premise and a conclusion set up, and the premise necessary to validate the argument determined.

These later operations would enable the switch-operated machine to carry out the main functions of Mr Molesworth's relay-operated "electrical brain."

We can put the matter by saying that any reasoning process has to pass safely through a number of tests before it can be labelled "valid." In other words, it must be free of all fallacies.

What we have to do, then, is to build into our fallacy finder a number of "traps" through which our electrical current (the line of thought) must pass safely before it can find a return path.

Each "trap" will represent one of the traditional rules for a valid syllogism.

The rules are:

(1) The middle term must be distributed at least once. (Otherwise, we have the fallacy of Undistributed Middle.)

(2) One premise at least must be affirmative. (Fallacy: Two negative premises.)

(3) and (4). If a term is distributed in the conclusion,

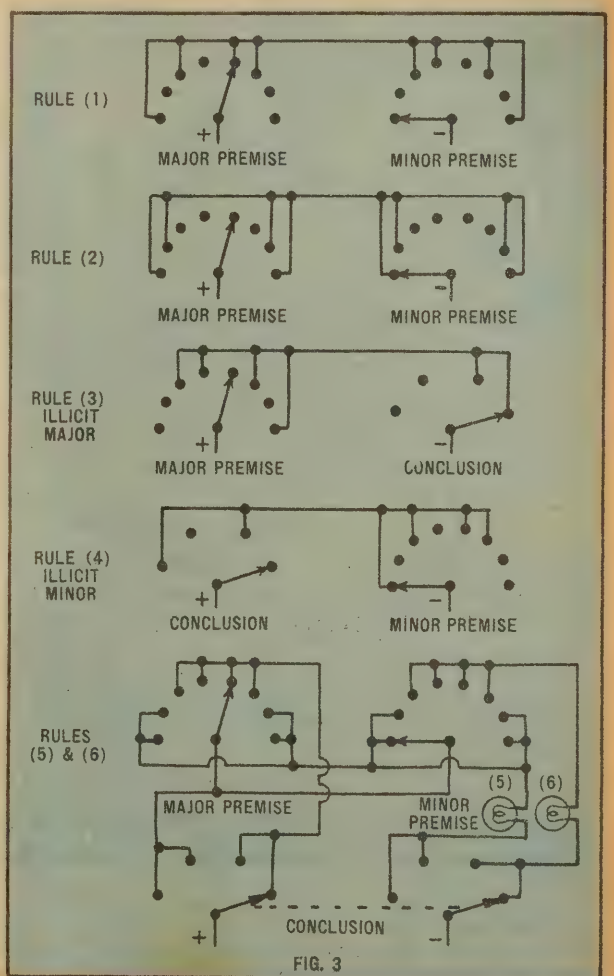

FIG. 3

*** This article is based on correspondence between the writer, David B. Andrew and Mr Molesworth. It has been amended slightly to suit it for publication.**

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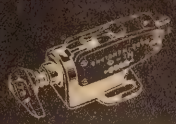

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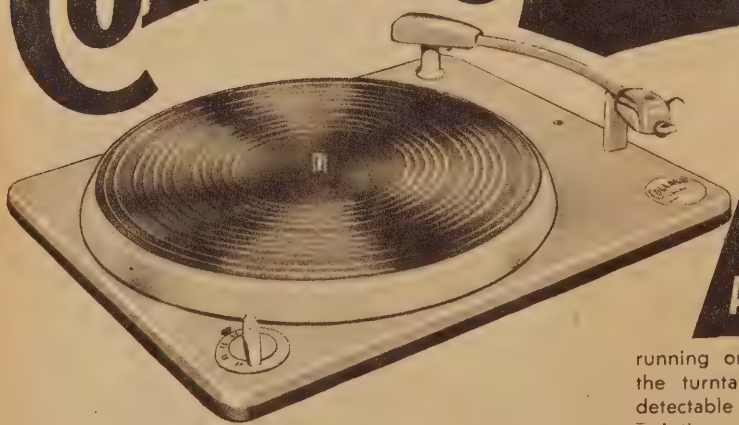

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t must be distributed in its premise. Fallacy: Either illicit major or illicit ninor.)

(5) If one premise is negative, the conlusion must be negative. (Fallacy: Affirnative conclusion from negative prenise.)

(6) If the conclusion is negative, one remise must be negative. (Fallacy: Negaive conclusion from two affirmative prenises.)

A term is said to be distributed when he whole of its extension is denoted in he proposition. This occurs with the ubjects of both universal propositions A and E) and the predicates of both egative propositions (E and O).

It is, of course, possible that more than ne of the above rules could be broken n a single reasoning process.

Two methods of devising an electrical

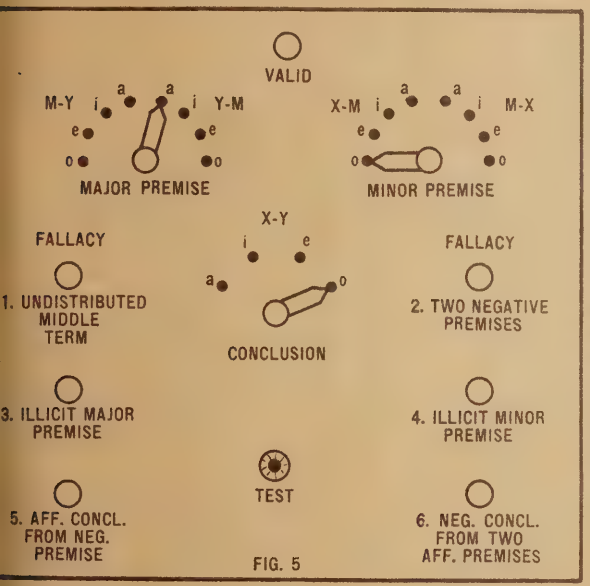

FIG. 5

series of "traps" representing these rules were worked out.

In the first method (Mark I) a separate circuit was provided for each rule, which would give a closed circuit only if the rule were satisfied.

For Rule (1), the circuit was as shown in figure 1.

Here, we have commoned all the contacts on one bank of each premise selector switch which correspond to propositions in which the middle term "M" is distributed.

The centre wipers are commoned, thus providing alternative paths.

The other rules were dealt with in a similar manner, although, for simplicity, Rules 5 and 6 were linked together.

An interesting rule of thumb emerged, namely that one bank on each switch was required on all switches involved in a particular rule (with a slight variation n the case of Rules 5 and 6).

In all, two 8 x 4 switches and one 4 x 4 switch were required, giving a otal of only 12 wafer banks for the SIX ules.

The six separate circuits were then conected in series with a battery, press-utton and lamp to produce the Mark I nodel (see figure 2).

The lamp will light when the switch s pressed only if the premise-selectors nd conclusion-selector are set in such a vay that each of the rule-circuits allows urrent to flow.

DETAILS OF THE FALLACY FINDER

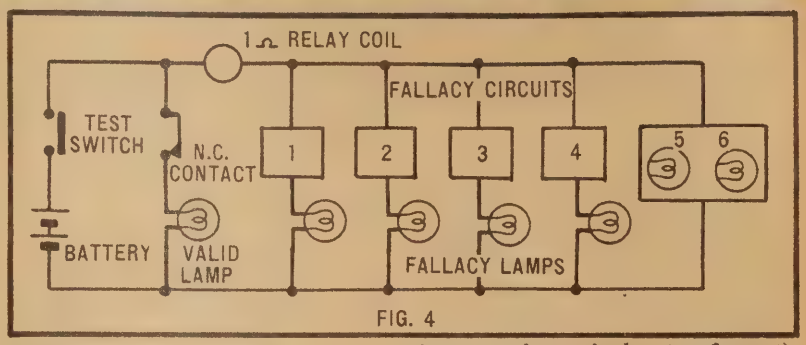

FIG. 4

☆

Based on the rules for testing a syllogism, this device has a set of "fallacy" circuits, each going to ground through a lamp indicating that a given rule has been broken. Should no rule be broken, the relay in series with the supply is not energised, its contacts close and the "validity" lamp lights.

☆

If any rule is broken, current cannot reach the globe.

After this device was built, the possibility of an improvement to include indication of the nature of the fallacy was realised.

Six relays could be used to do this.

A simpler approach was to re-design the rule-circuits to give a closed circuit when any rule was broken (see figure 5).

A lamp placed in series with each rule-circuit, which are themselves paralleled to the supply, will now indicate which of the rules, if any, has been broken.

Finally, a current relay with a set of normally closed contacts is included to light a lamp, indicating a valid syllogism, when no current is being drawn by the fallacy lamps.

This version (Mark II) has been built as shown in figure 4.

A suitable panel is illustrated in figure 5 on this page.

The relay was adapted from a 60-ohm disposals type by rewinding it with 22 S.W.G. gauge enamelled wire.

The whole device, with battery, measures 6in x 6in x 5in and is extremely simple to operate.

One drawback to this circuit is that, should a lamp be blown, then the relay will not be energised if only that rule is broken, and the "valid" lamp will still light.

A panel lamp test circuit could be easily added to make sure all lamps are in working order.

It might be said that such a device is not a "brain," but rather a complete tabulation of all possible syllogisms and their fallacies.

But who is to say if any machine is a brain and not just a complex set of predetermined possibilities incorporated by the designer.

LET'S BUY AN ARGUMENT

(Continued from Page 91)

matter of whether the system works or doesn't work.

Individual judgment enters into it.

More important, it doesn't necessarily prove, on a general basis, that adequate stereo effects can be achieved by having only the middle speakers separate.

Such a conclusion may be much too general.

The second letter, from J.K., assumes:

(1) There is a "hole in the middle," and

(2) Something must be done about it.

As I said earlier, the first assumption is by no means proven and is, in any case, mixed up with what the artists and engineer have sought in the first place.

The suggestion as to how to fill the hole is novel, to say the least.

Who is going to pay for microphones good enough to feed slave channels? And what of feedback and extraneous noises in the room?

And why a microphone channel, anyway, with its random effect on phase? Why not feed the slave units from the respective channels at any level which seems fit?

In short, I'm afraid J.K.'s suggestion doesn't enthuse me.

The letter on page 91 needs no comment in regard to the first two matters raised.

The third matter, regarding the colour sensation, gets back to what appeared in various technical journals after the B.B.C. had conducted tests on subjective colour sensations over their television channel. As I remember it, the sensations rely on the manner in which different segments of the colour spectrum activate the eye.

When viewing a rapidly moving black and white pattern, fringing effects produce a colour sensation.

OFF THE RECORD — NEWS & REVIEWS

I was somewhat intrigued, last month, to note Julian Russell's reaction to the initial releases on the new "Concert Disc" label. You may recall that his remarks were under the heading "Separation Carried Too Far?"

by Neville Williams

I AM wondering whether the phrase may not have special significance; whether the trend of events, whether we like it or not, will cause us to revise our ideas on what should or should not be, on stereo discs.

Whether the ones in question are a relic of the past or a herald of the future.

When stereo was first demonstrated, it was to the wonderment of all concerned that two substantially separate sets of information could successfully be written into the one groove—and subsequently extracted therefrom.

To exploit the fact and to demonstrate it to those who didn't know quite what to listen for, many early discs were cut with as much separation as could be achieved. Sound popped first from one speaker, then the other, earning for such discs the title of "gimmick records."

TIRED OF IT

But audio enthusiasts soon tired of gimmick for the sake of gimmick or, at least, found that one or two such records in their collection were plenty for demonstration purposes.

They began to look for something more subtle and important—for dimension and spread. They saw what stereo could offer, in sorting out the sound from massive sources, like choirs, grand organs and symphony orchestras.

These possibilities have since been realised. Certainly recording techniques vary, as do individual idea of loudspeaker placement, but the contribution that stereo can make is not in doubt.

Up till fairly recently, stereo has belonged to audio enthusiasts—to people who knew what to expect, knew what they wanted and were prepared to go to some trouble to get it. They realised that, to gain separation and spread, the sound sources had themselves to be separated, even at the expense of convenience.

More recently, stereo has passed into the hands of sales and advertising departments throughout the world and has become just another reason why people should buy a new radiogram. The inevitable has happened.

BARE MINIMUM

Machines qualify as stereograms, as long as they have a stereo pickup, two amplifiers and two speakers.

But what pickups, what amplifiers and what speakers!

Enormous pressure has been exerted on pickup manufacturers to produce units which will merely play stereo records and have enough output to drive the very simplest of amplifiers.

So, while portion of their lab. staff toil to produce something ever better for the audio enthusiast, others are set to meet the "popular" demand for output at any price.

Maybe the price will not be too high, but I am not optimistic.

I only know that the laws that govern these things dictate that, as properties are manipulated to gain output, frequency response becomes more restricted, channel separation is reduced and compliance becomes poorer.

This means increased weight, increased stylus and record wear and a total result which is not very nice.

With amplifiers, I have already implied dissatisfaction. It was skimping a design enough to drive an output valve directly from a mono cartridge. Now some manufacturers are demanding to drive two output valves directly from the two halves of a stereo pickup!

To cap it all, the speakers are placed in a common cabinet with no more than a couple of feet separating their two cones. Even assuming that the pickup can produce the two channels reasonably, that's about the distance you'd have to sit from the cabinet to hear the effect!

What chance has any "straight" stereo record of developing spread and separation under these restrictive conditions? It may contribute something, but certainly not as much as it could or should.

And what is the record manufacturers' attitude to be?

They could ignore the massive "popular" market and continue to produce stereo records to "purist" ideals. They could see the impression grow in this field that stereo records don't sound any different from ordinary ones. That the whole thing is an expensive confidence trick.

Or they could recognise the popular—if lamentable—trend and produce records with exaggerated separation such that only a deaf man with a mono pickup could miss it. This would leave audio enthusiasts, with separate speakers, to bemoan the spate of apparently "gimmick" records.

My tip is that neither extreme will be followed universally, but that the approach will be varied to suit the content.

I imagine that the tendency will be to retain the "depth and spread" technique for classical and large group music (a) because there is little other choice and (b) because such records go to the more discriminating market.

EXPLOIT SEPARATION

With "pop" records the tendency may be to exploit separation for whatever effect it can give, and to the extent the artist desires. And, in fact, it is obvious that some records are currently being made that way, with the feature artists dominating one channel and the backing orchestra the other.

We may or may not like this technique, but we certainly can't deny artists the right to use it if they want to. But it may cause us to admit another adjective into the context, viz: "separative."

Which leads us to a really horrible thought. Perhaps to hear tomorrow's pop records as the artist intended, we may have to wheel our speakers closer together "a la mob."

NEW BATCH OF SACRED RECORDS

LES BARNETT, Wurlitzer Organ, plays twelve popular hymns. Gospel Film Ministry. Mono., GFM7-W3032. L.P.

According to the jacket, Les Barnett has had a lot of experience as a popular organist, though his activities are currently directed towards religious ends.

His treatment of the hymns here is conservative enough, but his style is distinctly that of a popular organist—including an evident liking for tremulant effects and the more brilliant sounding pipes.

The hymns are well-known "revivalist" numbers including, for example, "Beulah Land," "All That Thrills My Soul," "At Calvary," "Onward Christian Soldiers," "Only Believe," etc.

Whether you like the record or not will depend mainly on your reaction to the Wurlitzer organ, for that is the sound and technique you buy on this disc. If you are partial to the Wurlitzer, you'll probably find yourself playing this one quite a lot.

On the technical side, the recording is clean and there is plenty of everything in terms of frequency response. On my disc, the surface was average—quiet most of the time, but with just a few patches where some background noise was evident.

★ ★ ★

D. J. REES, "Favourite Melodies for the Pipe Organ." Decca, Stereo, SKL4043.

This record is about as different as it could be from the Wurltizer offering above.

D. J. Rees plays in the manner of a traditonal church organist and choirmaster, on a good but equally traditional pipe organ, at Alltwen Chapel, Pontardawe, Glamorgan.

The selections, again twelve in number, are voluntaries which will be familiar to those who worship in larger churches. Typical are "Largo," "Jesu, Joy of Man's Desiring," "Trumpet Voluntary" and "Hallelujah Chorus."

The more complex passages leave no doubt as to what stereo can do for organ music of this kind. In the "Hallelujah

Chorus," particularly, with the eyes closed to blot out the two distracting loudspeakers, one can follow the notes as they run along ranks of pipes and as rank speaks to rank.

For the amplifier enthusiast, who may have ideas of stereo presentation to church groups, the record would be an excellent investment both in terms of content and presentation.

A slight tape or amplifier hiss is evident behind the quieter passage, but the surface of the disc itself is good.

★ ★ ★

THE CRUCIFIXION, Sir John Stainer. The Giuliana Chorale, cond. by Dr Paul Giuliana; John Couroy, tenor, Brandon Knowles, bass-baritone and Richard Elsasser, organist. Mono. MGM-02 7551.

This second LP version of the well-known Cantata, "The Crucifixion," reached me before Easter, but just too late for inclusion in our April issue.

It makes an interesting comparison with the GFM disc reviewed last month.

Technically, this new recording is the better of the two, the background noise level being lower and the solo voices not subject to the "metallic" quality for which I criticised the GFM disc.

But there, I think, the advantage ends. Obvious breaks occur between the individual sections of the new disc, so that it proceeds as a series of "takes" rather than as a composite cantata.

The soloists in the GFM disc seem more sure of themselves and carry more conviction; the choir is better disciplined and the organ rolls more ponderously. GFM also includes more of the hymns and the thief scene, which somehow gets crowded out of the MGM disc — I think—to its detriment.

One other point is that the GFM disc carries the words on the jacket, which some may count as a minor advantage.

In short, neither disc is perfect, but, all things considered, I would concede the advantage to the GFM version.

★ ★ ★

LEW CHARLES, Chimes, Celeste, Vibraharp and Organ, "Peace Be Still." GFM4—W3028—LP.

Unless my memory is playing tricks, Lew Charles was featured some years ago, as a theatre organist, on 78 r.p.m. discs. Whether or not this is so, he certainly has all the style and the tricks of the clan.

Currently, he is apparently taken up with religious activities and is credited, among other things, with composing and recording the score of the religious film "The Great Commission."

Nothing is said on the jacket about the organ itself or how the artist manages to play the selection of instruments credited to him. At first encounter, it sounds like an ordinary Wurlitzer set-up but, elsewhere, a characteristic electronic quality is evident, even down to faint key clicks. It could be a modern Hammond set up or an electronic Wurlitzer.

Whatever the method and mechanism, the result is pleasant and tuneful but with one major point of criticism—excessive use of the vibraharp. Not only is the effect overdone musically but the heavy beat pulse push the recording and reproducing system to the limit with a resulting occasional tendency to "break." In fact, it may spell tragedy on low-powered equipment.

This is a pity, because the disc is otherwise well recorded.

There are 13 hymns in all, well known and played in a style which is generally full and meditative. Typical titles are "Beautiful Garden of Prayer," "Wonderful Peace," "Someday He'll Make It Plain," "He Will Hold Me Fast."

★ ★ ★

JERRY BARNES, "The Voice of Jerry Barnes." Old-time hymn favourites as "The Shepherd of Love," "Others," "Only Jesus," "At Calvary," etc. GFM17—W3021—LP.

Jerry Barnes is a new name to me among the present array of American Gospel singers. He is credited on the jacket with "a rather deep bass voice," being "relaxed and listenable."

These adjectives are all completely justified, for Jerry Barnes is, indeed, easy to listen to, with more than a hint of Bing Crosby. What's more, he is variously and pleasantly backed by organ, piano, harp, accordion, bass, violin and chorus.

The solo voice is always well forward and the accompaniment restrained and disciplined. This is something that cannot be said of many comparable efforts.

Technically, the recording is clean and the noise level low. In fact I must say it: This is a record I can thoroughly recommend.

★ ★ ★

IN LIGHTER VEIN

NAT KING COLE, "Every Time I Feel the Spirit," with Gordon Jenkins conducting the First Church of Deliverance Choir. Stereo, Capitol SW1249.

When hymn themes are given the treatment by pop singers, I usually find the result pretty distasteful. But when the said hymn themes are predominantly Negro spirituals, the singer is the Negro son of a minister and he is backed by a church choir and a rhythm group, the result is something of an enigma.

It is debatable what is Negro, what is spiritual and what is pop.

In "Every Time I Feel the Spirit," along with some of the other numbers, the group here is much more concerned with musical gymnastics than anything else, but in "Sweet Hour of Prayer," "Nobody Knows the Trouble . . . " and "Steal Away" they create a very different atmosphere.

Sufficient to say that, whatever they are trying to do as a group, they do it very effectively, with every note—I imagine—just where the conductor and soloist intended it to be.

But my interest in the disc was—and still is—on a very different plane, for it's as nice a piece of stereo recording as you'll hear in many a long day.

The organ and other accompanying instruments stay at the left, the choir spreads across the background and to the right. Nat sings sometimes here, sometimes there, but mostly right out of the space where some people insist there must be a hole! The intimacy and presence of the voice from this position is electrifying and it's basically due to stereo.

Switch to Mono and the result is as flat as the underside of the proverbial pancake.

And all through the quality is clean —really clean—and the surface is really quiet.

Only you will know whether you have any use for Nat King Cole and spirituals in the modern idiom. But technically this disc is well worth hearing.

★ ★ ★

"SOUND IN THE ROUND"; Demonstration record, narrated by Tom Mercier. Concert disc, stereo, CS-22/7.

Most stereo amplifier enthusiasts seem to find a place in their collection for at least one demonstration disc—though goodness knows why, to judge by some of the efforts I have heard.

"Sound In The Round" is not one of the "music comes to life" variety. In fact, there is only one musical track on the whole disc, unless you count the Nickelodeon as music, or a march-past of bands, freely punctuated by crowd noises.

Primarily, it is a collection of the more dramatic noises encountered in life, strung together by the narrator, Mr Tom Mercier. In fact, on side two, the said Mr Mercier comes dangerously close to stringing the sounds "out" rather than "together."

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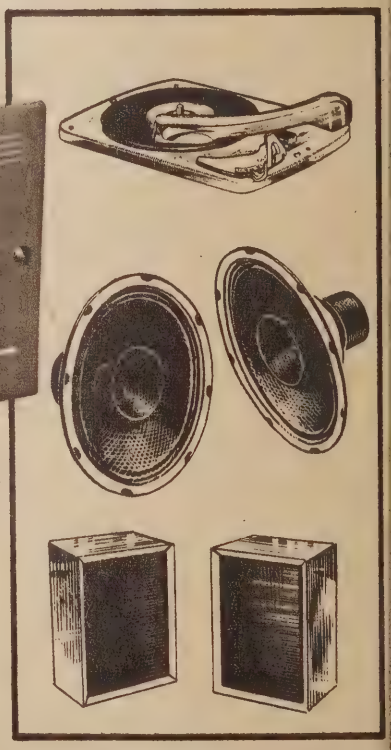

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However, he does provide welcome continuity, as against discs where track follows track, in an order known only to the person who happens to be holding the jacket.

Some of the effects here are very good indeed, others more ordinary. The ping-pong game (yes, another one) is excellent, as also is the steam train, the DC7 airliner and the carillon. But, for me, the old Nickelodeon steals the show by a head from the buggy and jack-hammer.

The surface is good, the recording is clean but you will notice, here and there, some variation in the quality of the narrator's voice and the character of the aperiodic sounds.

Perhaps this is inevitable, because their very nature required the recordings to be made at different times and under quite different acoustic conditions.

The point is mentioned only for the record. If there's a vacant place in your collection for a sound effects disc, this one could fill it. It's really very effective.

★ ★ ★

THE HARMONICATS, "In the Land of Hi-fi." Mercury, stereo, SR 60028.

I had something to say, last month, about the Harmonicats. Backed by a rhythm group, they play electronically amplified harmonicas — and play them very well indeed. Not a beat nor a note goes astray.

As for the title, it might better have been "More Harmonicats." I rated the last disc as technically excellent and the only real difference between the two is what they play.

The numbers, on this occasion, are as follow: "Twelfth Street Rag," "All of Me," "Sentimental Silly," "I Love You," "You Made Me Love You," "Did I Remember?," "Bye Bye Blues," "Heart of My Heart," "Swinging Down the Lane," "Diane," "What A Difference A Day Made" and "Jealous."

★ ★ ★

"STEPHEN FOSTER SONG BOOK," The Robert Shaw Chorale, conducted by Robert Shaw. R.C.A. stereo, SL16204.

Though he never quite fitted into the "white" society of his day, Stephen Foster did manage to capture and express southern Negro folk lore in a form which has a quite universal appeal.

It has been presented, the world over, in every imaginable form, even to being assembled, a few years ago, harmonic by harmonic, on the R.C.A. Music Synthesiser. The resulting sound I have always regarded as among the most intriguing in my record library.

This presentation by the Robert Shaw Chorale is purely vocal, the singers being virtually unaccompanied apart from occasional and "atmospheric" use of the banjo. Conditioned by the frequent use of organ or other backing by comparable groups, one has to resist an initial temptation to turn up the bass seeking something which the group simply doesn't use.

As might be expected, the singing is ordered and precise. In fact, the arrangements and tempo proceed as if time was no object, as it probably was not in the intention of the composer. Nevertheless, there is plenty of the necessary verve in "Oh Susanna" and "Camptown Races."

I make these remarks, not by way of criticism but simply to forewarn those who might buy the record expecting the contents to be otherwise.

The surface of the disc is very quiet, the quality clean and the rendition of the voices true. The stereo has been used in a purely matter-of-fact way, contributing dimension, without being otherwise exploited.

For your guidance, contents of the disc are as follow:

Side 1: "Ring De Banjo," "Beautiful Dreamer," "Gentle Annie," "Way Down In Cairo," "My Old Kentucky Home," "Old Black Joe," "Dolcy Jones," "The Queen of My Song." Side 2: "Old Folks At Home," "Come Where My Love Lies Dreaming," "Oh Susanna," "Gentle Lena Clare," "Nelly Bly," "Some Folks," "Laura Lee," "Camptown Races."

★ ★ ★

Wilbur Kentwell plays Astaire and Rogers, with Cyril Bevan drums. Columbia, Mono. 330SX 7537.

I listened to this record with a good deal of personal interest, having known Wilbur Kentwell personally for many years.

This record has presumably been made using the same technique which I have seen him use on television. A solo is first recorded on piano or organ as the case may be. This is played back while the artist provides an accompaniment on the alternative instrument, the two being recorded together.

Wilbur Kentwell has the technique down to a fine art, the lead switching from one instrument to the other without hesitation or loss of tempo.

Cyril Bevan, on the drums, provides support and further variety.

As the title indicates, the musical theme is the music made famous, through the years, by the team of Fred Astaire and Ginger Rogers. All the old favourites are there, from Cole Porter, Irving Berlin, George Gershwin and many o hers. The wonder is that so many favourites have been included, without undue crowding, on a single 12in disc.

If you like theatre-style organ music, you'll like this disc, the more so because the Hammond organ is used imaginatively throughout.

Recorded locally, the disc is technically good, with no trace of distortion or surface noise. But why not a few notes on the cover about the recording technique? They often add interest to the disc.

★ ★ ★

FLORIAN ZABACH, "Till The End Of Time," Stereo Mercury. SR60084.

I am not quite sure whom the comparison would please or displease, but Florian Zabach has been referred to as the "Liberace of the Violin."

Presented here as a popular violinist, his aim is for effect. His violin, reputedly a seventy-five thousand dollar Guarnerius, produces sounds from way up the scale, down to the lowest, throaty tones. At times it seems to mimic the human voice, but never once does it produce a harsh note.

Nor is the listener left in any doubt as to who is playing the said instrument. Zabach consents to share the left-hand channel only with a few percussion sounds. The rest of the backing orchestra have to crowd into the right-hand channel, like passengers into a second-class railway carriage!

But all this is comment, rather than criticism. The numbers on the disc can stand plenty of sentimentalising; numbers like "The Very Thought Of You," "Tenderly," "Anniversary Waltz," "Lovely To Look At" and "When Your Hair Has Turned To Silver"—to mention five out of the twelve.

In all, the treatment is varied, tuneful, sentimental—and easy on the ears.

The recording quality and general balance is excellent, and the background noise level commendably low.

★ ★ ★

"PENNARIO PLAYS." Chopin: Revolutionary Etude; Nocturne in D Flat. Rachmaninoff: Moment Musical, Melodie. Dohnanyi: Rhapsody in C. Saint-Saens: Etude En Forme De Valse. Poulenc: Mouvements Perpetuels. Scriabbin: Nocturne for the Left Hand. Paganini-Liszt: La Campanella. Mono, Capitol P8469.

Classical reviewers are inclined to criticise this type of disc as being too much of a hotch-potch for serious listening, yet too serious to be regarded as "background."

In so doing they overlook a considerable audience who find great enjoyment in listening to music of some substance but in the smaller segments. Far from being dismayed by the variety, they like it.

On this basis this latest offering of Leonard Pennario should find ready acceptance. The expert may observe some variation in his handling of the individual items, a minor slip in the Chopin Nocturne, a faulty piano note in the Scriabin Nocturne, and a slight mechanical buzz in a couple of spots in La Campanella, but these last are very minor effects.

My own reaction is that Pennario caters well for the designed audience.

The recording generally is clean, the piano tone good and background noise down to a very faint crackle.

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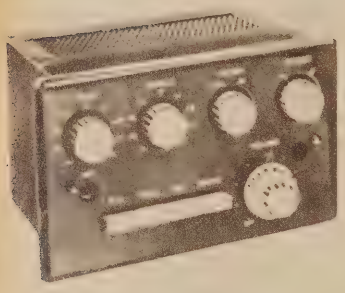

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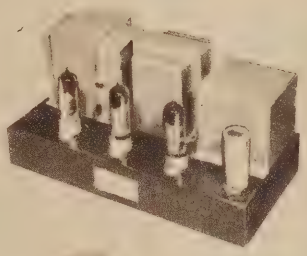

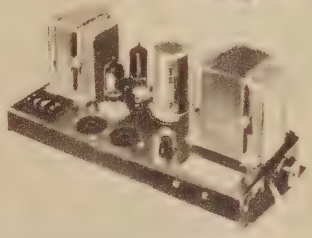

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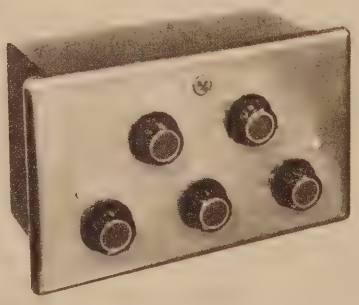

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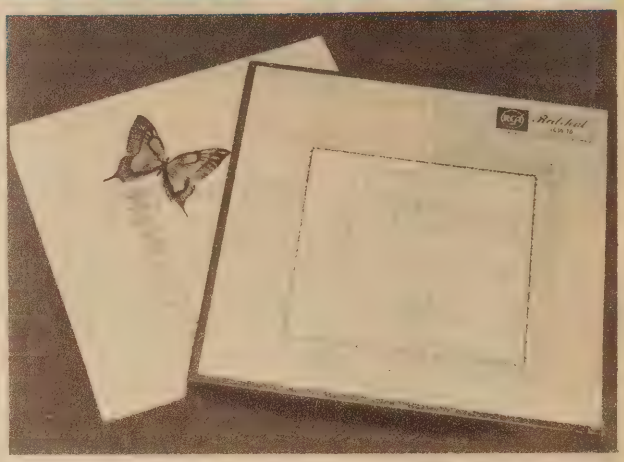
IN REVIEW—By JULIAN RUSSELL

The most notable release of the month is the new RCA Album of "Madame Butterfly." An excellent recording, musically, it is available in both mono and stereo versions.



Puccini — Madame Butterfly. Complete opera on three 12-inch discs in box with Italian/English libretto. Anna Moffo (Butterfly), Cesare Valletti (Pinkerton), Renato Cesare (Sharpless), Rosalind Elias (Suzuki), Fernando Corena (The Bonze). The Rome Opera House Orchestra and Chorus conducted by Erich Leinsdorf. R.C.A. Mono. LC16178.

This is a very impressive set indeed. Operas tend in time to acquire traditions which are often at odds with the composer's original intentions. Situations that were meant to be full of action freeze into poses, and characters imperceptibly build up foreign traits.

Butterfly is a case in point. The chief character has, over the years, put on weight and left the original girl-bride behind. The opera as a whole has grown less lyrical, become more melodramatic.

Erich Leinsdorf set about a re-examination of the score and had the good fortune to find a young soprano with a voice and personality fresh enough to re-create the original heroine. Nowadays it is rare to hear a Butterfly with the enchanting girlish quality of Anna Moffo and the capacity to realise all the drama allotted her by the composer.

Even in moments of extreme emotional stress Miss Moffo's voice remains pure and unstrained, her intonation dead true. She is a re-incarnation of the real Butterfly, simple, loving, constant and full of pride for her American "husband."

The pleasant, unforced lyrical quality of Valletti's tenor also adds to the effect that here we have two young people, both infatuated, he to the point of closing his mind to the harm he is likely to do, despite the warnings of his more experienced friend, the American consul, Renato Cesare.

In this set Valletti displays the best musical manners of any tenor recording Italian opera at present. He is expressive without "hogging the mike," and his voice is pleasingly free from the lachrymose inflections that mar many of today's bel canto performances.

All the minor characters are excellent and the whole show is held together with unquestioned authority by the conductor, Erich Leinsdorf.

The orchestra plays sensitively, but without affectation and the well-disciplined chorus retains its quality in even the softest passages.

The balance between singers and orchestra and between the instruments in the orchestra itself is consistently admirable. One or two of Leinsdorf's tempos are unusual, especially the slow beginning to Yamadori's entrance and the dragged pace of the "waltz" tune in the introduction to Act 3. Otherwise it is difficult to imagine a better set appearing for a long time to come.

Since the above was written, this set has also been issued in stereo. All the expected improvements are realised — greater breadth and perspective and general increase in the transparency of the registral texture. Miss Moffo's voice hardens a trifle at her entrance.

The change however, emphasises a slight lack of reverberation, especially noticeable in Act 1, and there was intermittent surface swish on the third side of my set. I must emphasise that all these qualifications are of little importance in view of the set's otherwise apparent merits.

★ ★ ★

Mozart—Serenades. No. 13 in G Major (Eine Kleine Nachtmusik) K525, No. 6 in D Major, K239, and Divertimento No. 2 in D Major, K136. Played by I Musici. Philips Stereo, AY835016.

You will find some delightful Mozart on this disc, recorded by the 12 Italian chamber musicians who were to have visited Australia this year. Previous recordings have demonstrated their impressive unanimity, the knife-edged precision of their attack and release and the subtlety of their collective nuancing. The stereo sound balances and spreads these features admirably.

I was surprised to find that they were not quite as sprightly as might have been expected in the first movement of Eine Kleine Nachtmusik. Though expressively played it lacks just the lilt that might have made it memorable. But the rest of the serenade is quite delicious, with an eloquent Romance, an enchantingly formal Minuet, and a Rondo that sparkles from beginning to end.

The light-heartedness missing in the first movement of this piece is transferred in good measure to the opening movement of the D Major Divertimento. Here everything is engagingly cheerful and graceful, setting off the youthful passion of the following Andante to perfection. A brilliantly played short Presto brings the work to an exciting conclusion.

The addition of timps to the combination in the first movement of the D Major Serenade supplies just the right amount of self-importance to this witty music in which, one feels, the young composer was laughing slyly at the more solemn of his patrons.

★ ★ ★

Beethoven—Piano Concerto No. 5 in E Flat (The Emperor). Played by Claudio Arrau and the Philharmonia Orchestra. Conducted by Alceo Galliera. Columbia Mono. 33-OCX-1653.

This is a good Emperor though a trifle disappointing when some of Arrau's other Beethoven recordings are remembered, notably his recent performance of the First Piano Concerto. It is stilll more disappointing to those who, three years ago, were lucky enough to hear his wonderful performance of the work in the Sydney Town Hall.

Many of the most impressive features of Arrau's playing can be enjoyed here —his fine range of expression, inimitable handling of pianissimos, elegant phrasing and dramatic changes of volume and tempo. But he never seems quite to fulfil himself, though many present-day pianists would perhaps be delighted to play the work as well as he does.

It is just not Arrau at his best and I cannot recommend it in favour of Solomon's superb performance for H.M.V. which is still on the local catalogue.

The engineering is good average, though this is a concerto that should pay rich dividends in a stereo version.

★ ★ ★

Beethoven—Piano Concerto No. 5 in E Flat (The Emperor). Sonata in G Major, Op. 79. Played by Andor Foldes, the Concerto with the Berlin Philharmonic Orchestra conducted by Ferdinand Leitner. Philips Stereo, SLTN138019.

The sound is, not surprisingly, better managed in this version though it is without any spectacular stereophonic effects. Discreet stereo is perhaps the best way to describe it. In fact the whole production errs a little on the side of discretion.

Foldes' is an eminently scholarly reading though without pedantry. He gives the impression of being just a trifle too cautious though his playing is always impeccably musical. This is an Emperor on a slightly smaller scale than Arrau's and often without Arrau's sensitivity. But it is still an eminently satisfactory one, if never great.

The orchestra provides an exemplary accompaniment, always matching the soloist's moods and his often rather too

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strict time keeping. And there is a bonus in the way of a fill—Beethoven's G Major Sonata, Op. 79, of which Foldes gives a very pleasing account.

★ ★ ★

Rachmaninoff — Piano Concerto No. 2 in C Minor. Played by Julius Katchen and the London Symphony Orchestra conducted by Georg Solti. Balakirev—Islamey, an Oriental Fantasy played by Julius Katchen. Decca Stereo, SXLA2076.

There is nothing timid about Katchen's fervent approach to this concerto. Here is unabashed romanticism controlled by a fastidious musical mind, executed with a technical skill that makes it all sound ridiculously easy.

And the C Minor is a work that responds gratefully to such treatment even if its composer himself tended to present it a little more formally. I think the secret of the success of this fine disc is to be found in Katchen's generosity, not only in the expenditure of his emotion but in the modest manner in which he retires to give way to the orchestra whenever necessary.

In this he is aided by first-class engineering that maintains a faultless balance throughout, has a great, though never unwieldy dynamic range, and puts the listener among heady, voluptuous sound. The orchestra is grand.

The Balakirev piece is one of the most difficult in all the vast literature of the piano. Undaunted, Katchen takes it at a pace that would make calamity seem always imminent in other, less skilled hands, but which in his, never gives the listener a moment's worry.

★ ★ ★

Marches from the Opera. Excerpts from Aida (Verdi), Faust (Gounod), Magic Flute and Marriage of Figaro (Mozart), Die Meistersinger and Tannhauser (Wagner), Carmen (Bizet), The Prophet (Meyerbeer), and Fidelio (Beethoven). Played by the London Philharmonic Orchestra conducted by Bernhard Linz. W and G. Stereo. WG-BMM-834.

These are marches in the strictest sense of the word, whatever their respective composers might have had in mind. For the most part they are presented with all the regularity of a parade ground drill. This has a curious effect on some of them, particularly the opening of the Carmen Overture. In some cases the original scoring has been altered, producing sound more reminiscent of a military band than a modern orchestra.

In the disc's favour must be added the fact that the sound is always clear and the stereo well spread.

★ ★ ★

Schubert—Trio No. 2 in E Flat. Played by the Immaculate Heart Trio. Capitol Mono, P8442.

This is a disappointing disc both in performance and engineering. The players, three nuns of the Immaculate Heart of Mary Convent, Los Angeles, seem never to feel the music very deeply, or if they do, fail to communicate any strong lyrical impulse. All three, however, have undoubted technical qualifications of a high standard.

Most of the work moves at an inflexible gait with the piano receiving more than its fair share of emphasis. Moreover the engineering is of the type that keeps the listener on the move adjusting the volume control.

This, set at a level that makes the first movement comfortably audible, brings in a greatly magnified cello in the second. Despite its imperfections, Casals' old Philips disc., issued some five years ago, is much to be preferred. My advice is to await something better in the future.

★ ★ ★

Tchaikowsky—Symphony No. 6 in B Minor (Pathetique). Played by the Philharmonia Orchestra conducted by Constantin Silvestri. HMV stereo OASD273.

This is a transfer to stereo of the mono issue of about two years ago. It has been made with outstanding success. The original mono, excellent in its way, has acquired new depth along with the spread one would normally expect. The sound is clean-cut though voluptuous, resonant though never reverberating.

A word of warning about Silvestri's performance, which will not prove to everyone's liking, especially those who dislike a frenetic reading of the work. The conductor's interpretation is highly individual. He seems to take the composer's score as merely a starting point to express his own personality.

Tempos are either faster or slower than you're likely to hear them elsewhere and the atmosphere is always surcharged with emotion. Silvestri doesn't always make normal pauses. Under his baton they often become chasms of silence, with the music perched dramatically on either side.

Strangely enough, if you can bring yourself to forgive such sensationalism, the effect is often exciting and does less harm to the musical fabric than might have been expected. But this might be due not only to the superb burnish on the playing of the orchestra, but to their flexibility in following a lead as capricious as Silvestri's.

★ ★ ★

Offenbach — Gaite Parisienne. Katchaturian — Ballet Suite from Gayne. Played by the Boston Pops Orchestra conducted by Arthur Fiedler. RCA Stereo SL16164.

This is as bright a performance of bright music, the Offenbach at any rate, as anyone could desire. The orchestra plays with great verve and accuracy and the work sparkles throughout like a chandelier. The character of the writing makes a great deal of it noisy, but it has its points of repose suitably placed throughout.

A tiny hint of reverberation hangs over a few passages here and there, but otherwise the sound is first-rate, beautifully spread without freakish separation. The brass has been particularly well recorded with a brilliant edge on it that never degenerates into stridency, while the strings combine vitality with richness of tone.

I found it all most invigorating—refreshing escapist entertainment after a hard day's listening to weightier stuff.

I have never admired the Gayne ballet music. It owes too great a debt to Borodin and displays little of the store of the original thought the composer draws upon in his other works. But it, too, is extremely well played and makes a good popular companion piece to the Offenbach.

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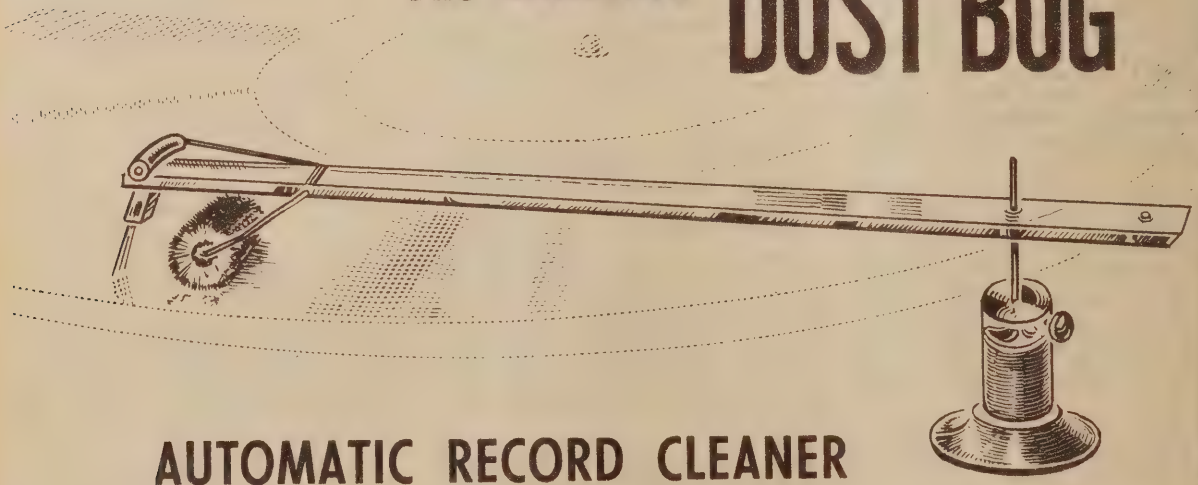

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Rodgers' music might be more interesting when illustrating the stage action it was designed to accompany. On its own it is not impressive. The composer seems to find it difficult to remove memories of Gershwin from his mind, and well-known little tunes — "Three Blind Mice" is one—are introduced from time to time, which anyone without a knowledge of the ballet will probably find as puzzling as I did.

The Gould Gavotte displays pleasing, off-centre treatment of this time-honoured form. His Blues, always very quiet, have a conventional, nostalgic quality. The musings of the piano played by Leo Litwin figure prominently in both items.

Bernstein's Galop and Waltz show real invention and great technical ingenuity. The pieces parody the early manner of Walton (Facade) without any actual resemblance. The Danzon is a delicious parody of South American dance music.

A highly efficient performance of "The Three Cornered Hat" provides opportunities for many showy solos, but I was disturbed by a quite loud tape hum in this item.

Shostakovitch's wry jesting in "The Age of Gold" is handled with wit and Ginastera's "Malambo" adds a good rhythmic romp, with the xylophone kept more than usually busy.

For Khatchaturian's "Sabre Dance," see above.

The sound is good average, without any particular distinction.

★ ★ ★

Debussy—Images for Orchestra—Gigues/Iberia — Rondes de Printemps. Played by the Boston Symphony Orchestra conducted by Charles Munch. RCA Mono L16209.

The Boston under Munch is usually at its best in French music and this most enjoyable disc provides no exception. The major work is the "Iberia Suite" in three movements, mature Debussy that might be described as impressionism with teeth in it. The dominating characteristic of Munch's sensitive performance is virility.

The first movement, "Highways and Byways," surprisingly strict in tempo most of the time, carries the listener along with it irresistibly. Though written by a Frenchman and played by an American orchestra, this is real Spanish music. Bright splashes of colour applied in huge daubs light up the quieter reaches of the score and the whole is beautifully rhythmic without exploiting the Spanish dance forms.

Then comes one of Debussy's most exquisite movements, "The Fragrance of the Night." This evocative piece of writing requires the most sensitive treatment. Its delicious woodwind solos, especially the oboe's, must never be allowed to show themselves off. They must all blend into the enchanted murmurings that surround them. And all this Munch manages with a scrupulous ear for balance.

The finale, "Morning of a Holiday," pictures all the bustle and excitement of preparations for a Fiesta. Here vigour must be added to elegance and again Munch's reading is impeccable.

In the "Rondes de Printemps," Munch is careful to ensure that the lovely haze of Debussy's impressionistic music is always supported by subtle rhythms that keep it moving forward. It is an impressive exhibition of fragility and strength.

Unfortunately, my pressing of this item is marred by slight swish, which can be ignored, but not without some effort on the part of the listener.

Gigues is a brilliant arrangement of Irish and Scottish tunes, many of which you will recognise, despite the ingenious things that happen to them. In this piece, Munch and his orchestra work in some truly stupendous climaxes.

The sound is good throughout and occasional slight prickles on the surface disappear from all but the quietest spots.

★ ★ ★

Arias in the Great Tradition—Abscheuler, wo eilst du hin? Ah, Perfido! (Beethoven), Leise, Lise; Cavatina from Der Freischutz (Weber). Solo un Pianto (Cherubini), Grands Dieux, du destin, qui m'accable (Gluck). Sung by Eileen Farrell, with orchestra conducted by Max Rudolf. Coronet Mono KLC2697.

Miss Farrell offers superb singing of great arias. These are no ear-ticklers, but sublime examples of vocal writing. Miss Farrell's voice is of noble proportions and she controls it with great technical resources. It is even throughout a great range that extends from a full-throated mezzo low register to top notes of a purity and steadiness that puts her among the great dramatic sopranos.

Her phrasing, which seems always to find just the right place for the cusp of a line, is broad enough to indicate limitless reserves of breath. Yet, big as her voice is, it never sounds unwieldy. On the contrary, she can skip about in some passages with an agility that a coloratura soprano might well envy. She demonstrates this surprising nimbleness in "Leise, Leise."

Here is a recital that is richly satisfying from start to finish. It is indeed great music, sung with great musicianship. Some slight reverberation in the Beethoven pieces gives the impression that she is performing in an empty hall. Otherwise, the sound is very fine indeed.

Max Rudolf's un-named orchestra provides admirable accompaniments blemished only to the tiniest degree by some slight muddiness of orchestral texture in a few bars of the Beethoven.

★ ★ ★

Moussorgsky — Pictures At An Exhibition. Rimsky-Korsakov — Cappricio Espagnol, played by the New York Philharmonic Orchestra, conducted by Leonard Bernstein. Coronet, Mono KLC2706; stereo KLCS2706.

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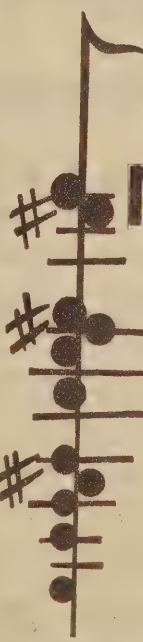

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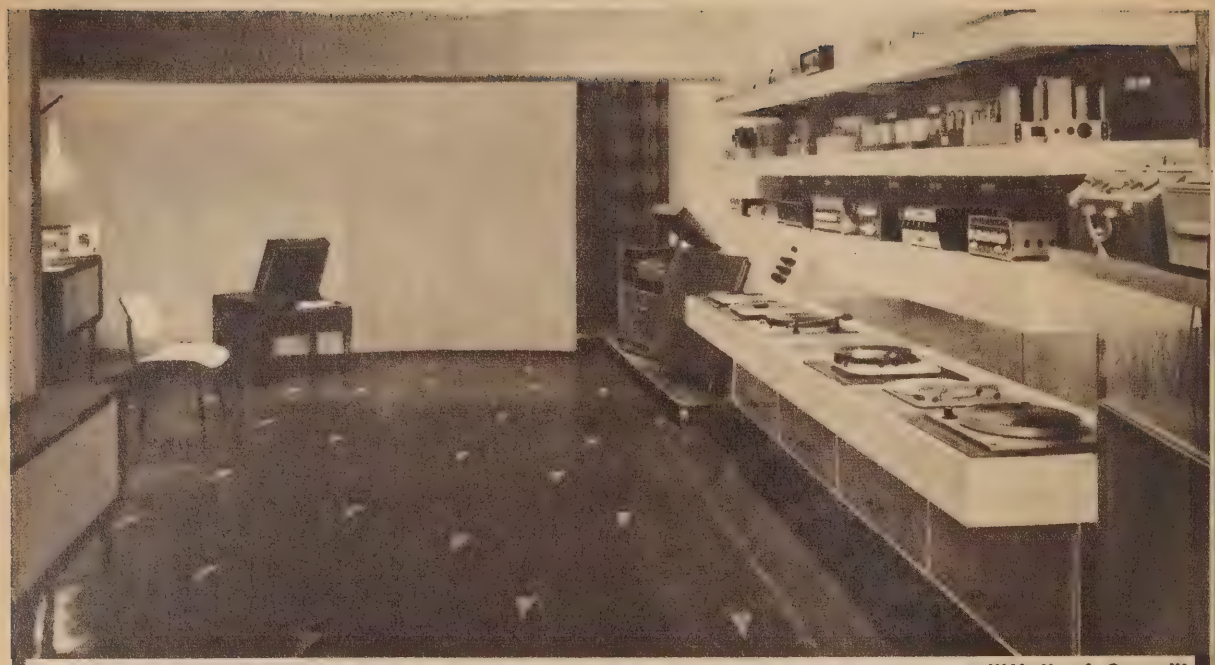

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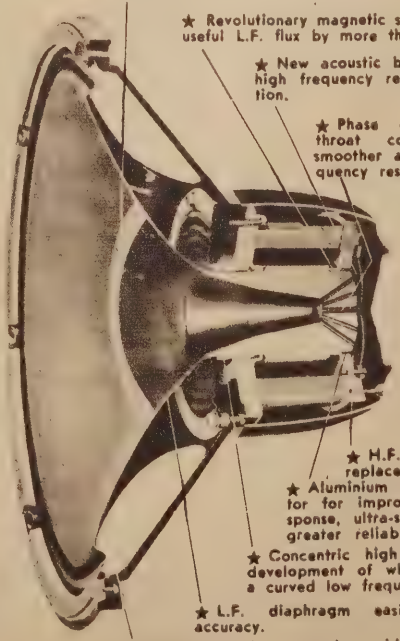

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The sound on both these discs, mono and stereo, is outstandingly good. It has to be, of course, to stand up to competition from earlier recordings of the Moussorgsky, many of which were landmarks in sound engineering.

At any rate, here are the "Pictures" again, better recorded than ever, even if not quite so satisfactorily played as on some of the previous occasions. This might seem a little inconsistent an opinion in view of my admiration of the players' individual skill. But there is a tendency in at least two of the leading American orchestras — the Philadelphia, and more recently, the New York Philharmonic under Bernstein—for the soloists to do what I can only describe as "show off."

They have a disturbing air of infallibility and self-advertisement. Some of Bernstein's tempos are on the deliberate side, as if to provide his combination with plenty of elbow-room to manoeuvre in but, when he gets going he can be very exciting indeed, even to my perhaps prejudiced mind.

Much the same might be said of the Rimsky-Korsakoff suite but, while the disc might find only limited appreciation among musical purists, it will be quite a star piece for audiophiles.

★ ★ ★

Rimsky-Korsakoff—Capriccio Espagnol. Tchaikowsky — Capriccio Italien. Borodin—Polovtsian Dances from Prince Igor. Moussorgsky — Prelude to Act 1 of Khovantchina. Played by the Cleveland Orchestra conducted by George Szell. Fontana, Stereo 876502CY.

The sound on this is excellent, too, though it lacks the opulence of the Coronet mentioned above. The revelation of orchestral detail is impressive and the sound is satisfactorily spread, though I found the slightest hint of distortion in a few bars of the Polovtsian Dances.

But the playing throughout is infinitely more subtle than you will find in the New York Symphony's. Szell's chaste style is not to be betrayed even by the vulgarities of the Tchaikowsky item. It remains as immaculate as if he were playing Mozart. Yet there is no reticence and the conductor is always alert to highlight a dramatic effect when it is within the bounds of good taste to do so.

And the Rimsky-Korsakoff has a rhythmic vitality that is missing from the Bernstein performance. I was disappointed, however, in the Khovantchina excerpt, which is supposed to represent dawn over the Moskva River. Szell makes it a very chilly, unromantic morning scene.

★ ★ ★

Kol Nidre Service—Jewish prayer service for the Day of Atonement. Composed and conducted by Sholom Secunda. Sung by Richard Tucker with Shofar (a ram's horn blown during the ceremony).

I had always understood the origins of this music to have reached back many, many hundreds, even thousands of years. But there is nothing in the version presented here to suggest anything older than the last century. It sounded to me like a debased form of Jewish "plainsong," to use a handy, if perhaps not too accurate, comparison.

Since my own knowledge of the subject is slight, I consulted a Sydney

(Continued on Page 123)

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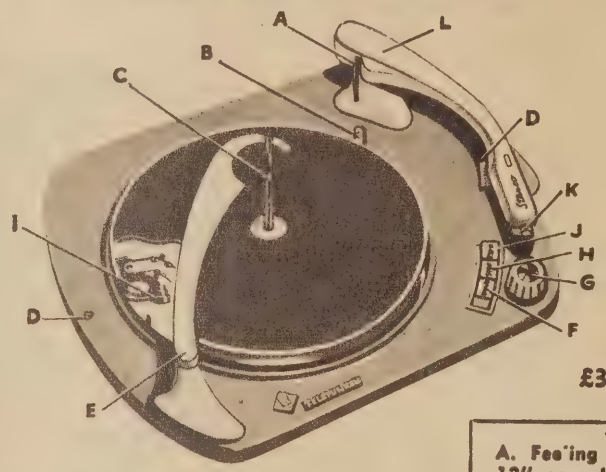

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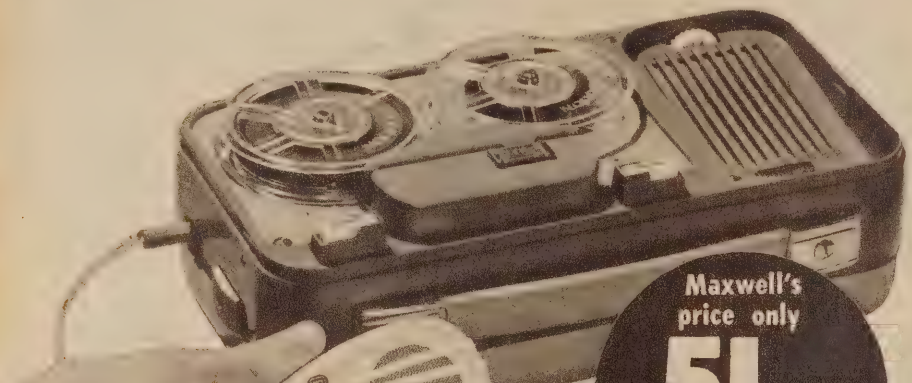

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BOOKS-REVIEWS AND COMMENTS

BASIC THEORY AND APPLICATION OF TRANSISTORS. Published by Headquarters, Department of the Army, U.S.A. Contains circuits, diagrams, and curves. 263 pages.

This book, which has been adopted as a text book by the Royal Melbourne Technical College, is quite comprehensive and thorough in its coverage of transistors and their application. After a brief history of semi-conductors, the book deals quite fully with atomic structure, conduction, crystal lattice phenomena and semi-conductor basics.

The transistor is then dealt with as an amplifier and its characteristics, parameters, and associated equivalent circuits introduced. The question of bias stabilisation is treated in some detail and transistor circuit analysis explained.

The application of transistors to audio, tuned, and wide-band amplifiers is dealt with at some length, and is also the various transistor oscillator circuits. Transistor pulse and switching circuits are also treated quite fully, considering the size of the book.

Finally, a small section is devoted to other semi-conductor devices. It should be noted, however, in reference to this book that, although it starts from scratch so far as transistors are concerned, it is not a book for the beginner to electronics. The book is written intentionally for technicians and other folk with a reasonably technical background.

Having regard to the information contained, the book represents very good value.

Our copy from Technical Book and Magazine Co. Pty. Ltd., 295 Swanston Street, Melbourne. The price in Australia is 16/3, plus 2/ postage from the above firm.—(J.R.).

★ ★ ★

HOW TO USE GRID-DIP OSCILLATORS by Rufus P. Turner. Soft cover, 112 pages, 5½in x 8¼in, containing diagrams, photographs and circuits.

This book fills the long-felt need for a guide to the operation of the Grid-Dip Oscillator. This instrument seems to have a mixed reception among electronics workers and, indeed, a lot of untrue qualities have been assigned to it in the past. This book really treats the oscillator and its particular technique fully and thus clears the situation of any mystery.

The first chapter is devoted to the principle of the grid-dip oscillator, and the usual combination of these with wavemeters for versatility. The second chapter deals with grid-dip adaptors for standard signal generators and also introduces the transistorised "dipper."

The following three chapters are concerned with Resonance, Capacitance and Inductance measurements; various methods of coupling; "Q" measurement and frequency considerations are explained.

A complete chapter is then given to applications of the "dipper" to receiver servicing and alignment. The uses of the instrument in television, FM and interference-suppressing wavetraps are also explained.

Transmitter checking applications are then given and the use of the unit for tuning, neutralising and parasitic detection (with power either off or on) is explained. Using the instrument for antenna and transmission line tests and measurements is also discussed.

The final section of the book is devoted to miscellaneous applications, and a review of commercial American Grid-Dip Oscillators. A section is given to the calibration of a typical G.D.O., and the use of the instrument to test quartz crystals is explained. Finally, seven commercial instruments are examined.

The book would appear to be very suitable for the person contemplating the building of such an instrument and also for the user who desires to obtain the maximum usage from his present instrument.

Our copy was from the publisher, John F. Rider Publisher, Inc., of New York, but the book wil probably be available locally in due course. (J.R.)

★ ★ ★

HOW TO USE METERS by John F. Rider and Sol. D. Prensky. Soft cover, 216 pages, 5½in x 8¼in. Contains diagrams, circuits and photographs.

Intended as a guide for engineers and technicians as well as beginners to electronics, this book deals with electrical meters in practically every phase of electronics in which they appear. Not only are the basic principles of meter operation explained but the applications, and latest developments in meterised equipment are treated.

The initial chapters are devoted to details of meter construction and the ways are explained by which meters are adapted by means of shunts, rectifiers and multipliers to measure various electrical quantities. Resistance measurement and power measurement are treated and the meaning of readings on polyphase AC systems explained.

ERRATUM KARSET

READERS attention is drawn to an error in the circuit for the 1959 Karset (June, 1959).

The 22K oscillator grid resistor (12AD6) is shown connected to chassis, but should be returned to the "A" supply line. This is of little importance when the "A" line is at chassis potential, but will upset the oscillator stage when a positive earthed electrical system is used.

It is suggested that readers amend their own file copy to prevent possible confusion in the future.

Further chapters introduce current transformers and other appliances used in audio and power frequency measurement, including clamp-on ammeters and ammeter adaptors. The adaption of meters to RF measurements is then explained, and the thermocouple, hot-wire and diode type instruments are treated.

The construction of multi-range measuring instruments is then discussed, and switching and termination of ranges explained. The electronic type of voltmeter and ohmmeter is discussed, including the simple triode, two-valve bridge and amplifier types.

Chapters are devoted to showing applications of meters in various pieces of equipment and to various circuit measurements. The use of meters in servicing of radio and television receivers is discussed and the use of tests of voltage, current and impedance in electronics analysis explained.

Finally, the application of meters to specialised electronic measurement is discussed and the modern developments of digitised electronic voltmeters and automatic range-switching multimeters shown and explained.

Our copy of the book was direct from the publishers, John F. Rider Publisher, Inc., of New York. No Australian price was given, but the book will undoubtedly be available locally in due course. (J. R.)

★ ★ ★

HOW TO GET THE MOST OUT OF YOUR V-O-M, by Tom Jaski. Gernsback Library Book No. 85. Soft cover, 223 pages, 5½ x 8½ inches. Contains photographs, circuits and diagrams.

Covering practically every aspect of volt-ohm-milliameter practice, this book is intended both as a guide to their use, and as a text on their operation. Apart from the theoretical treatment of "vom" operation and use, however, the book gives practical circuits of suitable units for home construction and also details of various adaptors and accessories for an existing instrument.

The initial chapter is composed of details of moving-coil meter construction and operation, and gives detail on balancing of meters when this is necessary.

The second chapter examines the meter with regard to its incorporation in a multi-range instrument, and shows ways of determining full-scale sensitivity, internal resistance and suitability for various uses. The theory of shunts, multipliers, and the various types of ohm meters is explained and methods of calibration introduced.

The third chapter gives some practical designs for volt-ohm-milliameters suitable for home construction and the following chapter discusses kit type instruments and refers to the specialised type of construction used in these.

A review of various commercial instruments follows, with attention to any particular feature possessed by each. Another chapter describes range extension adaptors, and shows ways in which the normal instrument can be used to measure inductance, capacitance, and AC Power Factor.

Uses of the "vom" as a general measurement device in electronic equipment are then explained, also the ways in which it can be substituted for various components, for purposes of circuit analysis.

Further details of "vom" as a testing instrument are given, with particular reference to more specialised techniques concerning television receivers and amateur transmitters; a final section deals with industrial electronics.

Our copy of the book was from the publishers, Gernsback Library Inc., of New York, and the Australian price was not given. However, the book should be made available locally in due course. (J. R.)

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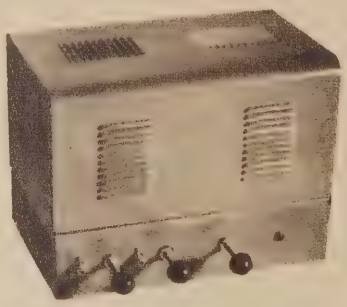

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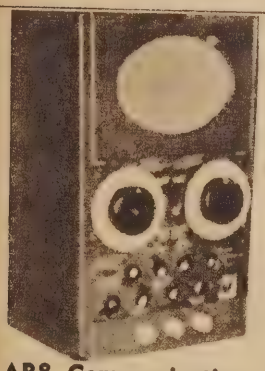

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AMATEUR BANDS WITH BILL MOORE

AMATEURS PERTURBED BY LOSS OF FREQUENCIES

Radio amateurs in Australia are perturbed by the suggested cuts to amateur bands decided upon at the Geneva I.T.U. conference. According to reports they have lost more frequencies than any other nation's amateurs and are endeavouring to have the matter reconsidered and aired in the Federal Houses of Parliament.

THE final outcome of the Geneva ITU conference as affecting amateur radio throughout the world has been the subject of much comment in all parts. Here, at the time of writing, an official proclamation has not been made, but John Moyle, VK2JU's final report as appearing in "Amateur Radio," presents the details as available. Full reviews have been published in overseas amateur radio journals.

Region II suffered no frequency allocation reductions. Amateurs in Regions I and III, however, suffered cuts of varying degrees.

THREE REGIONS

The areas covered by the various regions are as follows: I—Europe, Africa and a portion of Asia; II—the Americas; III—the Pacific area and the parts of Asia not in Region I.

The salient points made in John's final report, especially regarding future planning to ensure effective representation on frequency allocation committees well before ITU conferences, will have to be closely followed if we are not to suffer serious frequency losses.

It is interesting to note that Australia's suggestions for the reduction to amateur bands were the most drastic offered by any English-speaking nation. Many years ago, the late K. B. Warner, W1EH, manager of the ARRL, observed that all important work with reference to amateur privileges for any national group was performed many months before an ITU conference and even doubted the value of IARU representation at such conferences.

He observed, too, that it was essential to plan, even years ahead, in liaison with local administration and that the most valuable contributions were made at this stage.

"MISSED THE BUS"

Here in Australia we undoubtedly missed the bus on the last occasion, though it was not for the want of trying at departmental level. On the next occasion it must be a very concerted Australia-wide effort on the highest possible plane to obtain representation on any frequency allocation committee.

Amateurs are again working to ensure the fullest publicity is being given in the right places to the cuts now proposed. A number of questions have been asked in the Senate and House of Representatives on the subject of the ITU deliberations and it was stated that the matter will be reviewed by the Federal Cabinet about the end of April.

Some interesting features are noted in overseas reviews of the Geneva workings and some of the points made are listed.

The conference opened on August 17, 1959, and finally closed on December 21, 1959. It was of interest to note that the chairman was an active amateur, as also was one of his vice-chairmen. Nearly 100 licensed radio amateurs were present at the conference, many of them holding important posts in the various delegations.

The most enthusiastic official delegations supporting amateur radio were the U.K., United States, New Zealand, Canada and South Africa.

Most delegations, however, referred to the importance of the amateur radio service. A tremendous power was wielded per medium of the ballot box by the new developing nations, some 30 in number, and most of these were keen to achieve equality with the more senior nations in allocation matters. It was the impact of these new nations that was to spell the reduction on the 7 Mc/s band in most areas. Most observers hesitate to forecast what is likely to happen to the 7 Mc allocation at the next ITU conference—that pressure was really on.

TECHNICAL PANEL

The Geneva conference decided to set up a panel of technical experts to examine the whole of the frequency requirements between 4 and 27.5 Mc/s and it is certain that the requirements of these new nations will be under consideration. Nearly 90 nations were represented at the conference and, in just on 60 of them, there are national amateur radio societies.

A general idea of the world-wide frequency allocations and some of the variations follows:

1.8 Mc/s—an assignment of 200 Kc/s between 1,715-2,000 Kc/s is available to amateurs in many parts of Europe and Africa with a mean power not to exceed 10 watts. 1,800 to 2,000 Kc/s is available in Regions II and III on a shared basis with other services.

3.5 Mc/s — This allocation is little changed, except in Australia and India. Region I retains 3.5 to 3.8 Mc/s, Region II retains 3.5 to 4.0 Mc/s, Region III 3.5 to 3.9 Mc/s, excepting Australia, 3.5 to 3.7 Mc/s, and India, 3.89 to 3.9 Mc/s.

The VK allocation is reputedly exclusively amateur but, while the allocation in the region is shared, and we have other nations' stations operating close by, it will not mean any great change.

7 Mc/s—This band now reads 7.0 to 7.1 Mc/s in all regions except Region III, which retains its previous 7.0 to 7.3 Mc/s allocation. There was one rider that, for amateurs in South Africa and S.W. Africa, 7.1 to 7.15 Mc/s is shared with S.W. broadcasting.

The U.S. delegation made a bold bid to introduce a regulation that the reduced allocation 7.0 to 7.1 Mc would not come into force until this segment has been cleared of all S.W. broadcast stations. The motion was lost, however, when put to the vote.

14 Mc.—This band remains as a world-wide allocation from 14 to 14.35 Mc. Australia provided the main suggestion of a reduction (by 100 Kc), but according to overseas reports, was withdrawn in the sub-committee stage, due to the efforts of John Moyle, VK2JU.

21 Mc.—The status quo has been maintained for the amateur service on a world-wide basis for 21 to 21.45 Mc.

SPECIAL FREQUENCY

The frequency 27.120 plus-minus 6 per cent may be used by amateurs in region II and Australia and New Zealand, although the allocation is for the Industrial, Scientific and Medical Service. The conditions for operation are unknown.

28 Mc.—Remains at 28 to 29.7 Mc in all three regions. There was a number of proposals that the band be shared with fixed services.

50 Mc.—This band is not available to any amateurs in Europe but in other sections of Region I it may be used. Amateurs in Regions II and III can use it on an exclusive amateur basis.

144 Mc.—144 to 146 Mc remains an exclusive amateur allocation in all regions. Amateurs in Regions II and I also are permitted to use 146 to 148 Mc. The Australian band will be reduced and removed to 148 to 150 Mc on July 1, 1963.

220 Mc.—This band, 220 to 225 Mc, will continue to be allocated to the amateur service in Region II. Rhodesia and Nyasaland are the only countries in Regions I and III permitted to use the band.

Other allocations granted, all in UHF portion of the spectrum, are as follows: 430 to 440, 1,215 to 1,300, 2,300 to 2,450, 3,300 to 3,500, 5,650 to 5,925, 10,000 to 10,500 and 21,000 to 22,000 Mcs. Conditions of operation vary in the different regions.

The Geneva Radio Conference regulations are due to come into force on May 1, 1961.

All amateurs will be notified officially on the exact conditions of operation.

The Atlantic City Convention's defi-

tions of "Amateur Service" and "Amateur Stations" have been retained. Argentina proposed that the "Amateur Service" be known as an "Activity" rather than a "service" but, due to work behind the scenes, mainly by IARU observers, the proposal was withdrawn.

Administrations may, if they so desire, waive the Morse requirement for those amateurs that intend to operate exclusively on frequencies above 144 Mc.

The Q code was extensively modified. It has been decided to qualify the degrees of QRM and QRN by adding the numerals 1 to 5. QRM1 would denote there is no interference and QRM5 would denote that interference is extremely bad. The QRK abbreviation has also been amended to cover QRK1 to QRK5 to show degrees of intelligibility.

General reaction to the final amateur allocation has been rather violent here in Australia. It could have been worse only for the work of the WIA's ITU delegate.

Amateurs are justified in wondering why the Australian proposals were so far out of line with the general ideas of English-speaking nations. They can only conclude that the administration, at least to some degree, is anti-amateur. This country's frequency allocation requirements for other than the amateur service could not be compared with those of the major nations who proposed no or few allocation changes to amateur bands.

The ARRL's QST report on Geneva suggests the next ITU conference is only about five years away.

All amateurs must work to ensure their case for frequency allocations is effectively presented well before this time.

W.I.A. notes

DURING March most sections of the W.I.A. in N.S.W. elect their office-bearers for the ensuing year. Old officers retire, new ones take over the reins and tackle the problems facing the amateur service. Work on the various committees is often arduous and changes in personnel are inevitable if the family equanimity is to be maintained and personal sanity restored.

The Hunter Branch of the N.S.W. Division election results as follows: President, Lionel Swain, VK2CS; vice-president, Varley Fitton, VK2SF; secretary, Gordon Sutherland; treasurer, Bill Hall, VK2XT; zone correspondent, Bob Rose, VK2AQR; social secretary, Gordon Sutherland; social treasurer, Bob Bailey; liaison officer, Stuart Fairburn, VK2ZDF.

Another election held during the month was that of the Blue Mountains section of the W.I.A. Office-bearers: President, Keith King, VK2ABK; vice-president, Jack Greenhalgh, VK2ADF; secretary, Bill Moore, VK2HZ; treasurer, Norm Durham, VK2QA; catering officer, Mrs May Stahl; technical officer, Wal Romie, VK2MZ; delegates to division, Bob Lear, VK2ASZ, and Les Stahl.

The Gosford Radio Club, Central Coast section of the W.I.A., election resulted as follows: President, Major Collett, VK2RU; vice-presidents, Jack Ferguson, VK2FJ, and Doug Pearson, VK2ASA; secretary, Reg Brooks, VK2AI. Lecturer at their annual meeting was Frank Hine, VK2QL, who told members of ionospheric prediction charts and their interpretation.

The major election was that of the divisional council of the N.S.W. division of the W.I.A. Actually no election was necessary, as only seven members, the required number, nominated for council.

The council for 1960-1961 is as follows: Frank Hine, VK2QL; Bill Lewis, VK2YB; Tim Mills, VK2ZTM; Phil Pearson, VK2ZBB; Max Pleffer, VK2MP; George Rutter, VK2CB, and Ted Whiting, VK2ACD.

N.S.W. OFFICERS

At the inaugural meeting of council the following members were elected to specific positions: State president, Ted Whiting, VK2ACD; vice-presidents, Max Pleffer, VK2MP, and Frank Hine, VK2QL; secretary/treasurer, Norm Beard, VK2ALJ. Officer-in-charge of VK2WI Dural, George Rutter, VK2CB, and his committee, Dave Duff, VK2EO, Les Stahl, plus VHF section and SWL section representatives to be elected.

QSL officer, Frank Hine, VK2QL; assistant QSL officer, Noel Taylor, VK2ASQ; zone liaison officer, Max Pleffer, VK2MP; education officer, Max Sobel, VK2OT; class manager, Leon Parr-Smith, VK2AOJ; social committee, Max Pleffer, VK2MP, and Phil Pearson, VK2ZBB; Federal traffic manager, Dave Duff, VK2EO; circulation manager and assistant secretary, Tim Mills, VK2ZTM.

The bulletin committee comprises Max Pleffer, VK2MP; Ted Hockin, VK2AIE; Tim Mills, VK2ZTM; Phil Irvine, Joe Pollock and Bill Lewis, VK2YB. VK2WI broadcast committee, Dave Duff, VK2EO; Ted Whiting, VK2ACD, and additional members to be elected.

The administration building committee comprises Bill Lewis, VK2YB; Norm Beard, VK2ALJ; Phil Pearson, VK2ZBB; plus representatives of the VHF and SWL sections.

A number of positions have still to be filled and elections will be held at a later date.

The council will meet eight days prior to normal general meetings, on the third Thursday of each month, and visitors are welcome. The venue, the administration building at Crow's Nest.

VHF, TV SECTION

The N.S.W. VHF and TV section of the WIA held their election of officers early in April. The following office-bearers were elected: President, Bob Winch, VK2OA; vice-president, Phil Card, VK2ZBX; secretary, Bob Ridgely, VK2ZAR; and committee members John Lark, VK2ZAV, Lance Phillips, VK2ZKP, and Barry Goodman, VK2ZAG.

The chairman's trophy presented for the highest scorer in field events was won by Jim Cummings, VK2PM, with 30 points; second to Jim-Dave Andrews, VK2AWZ, 24 points; third, Allan Hennessy, VK2RX.

The annual meeting of the N.S.W. division of the WIA was held at Science House on March 25. Approximately 80 members were present. The retiring president, Dave Duff, VK2EO, was in the chair and presented the annual report previously circulated with the monthly bulletin. The treasurer's report and balance sheet were adopted.

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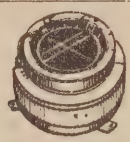

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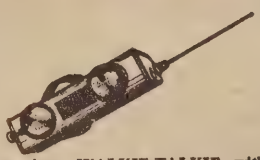

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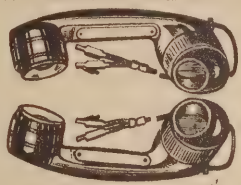

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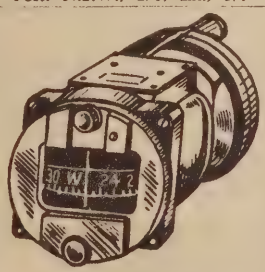

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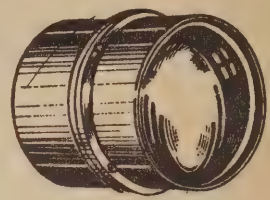

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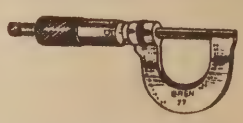

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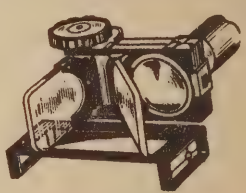

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The declaration of the result of the annual election of council was made (reported elsewhere) and Jim Cummings, VK2PM, was again elected auditor.

At the instigation of the Federal executive of the WIA ideas were solicited from all divisional members for a suitable national memorial to be established in memory of the late John Moyle, VK2JU. The N.S.W. division has also been considering the erection of an appropriate memorial and many suggestions have been received. The one most supported was the proposal for the building of gates at the entrance to the VK2WI grounds at Dural.

A loss to the N.S.W. division of the WIA was the retirement of Allan Williams, VK2FH, from their disposals committee. The committee over many years has performed a tremendous job for the amateur in N.S.W. and the N.S.W. division in particular. There has been a steady flow of valuable equipment being made available to amateurs and SWL's alike. Amateurs wish Allan well and hope he will soon be really active in the amateur service again.

Radio club

AN Amateur Radio Club has been formed in Young and 25 persons attended the inaugural meeting held on April 1. The president is Errol Eastley, VK2VT; vice-president, Peter Page, VK2APP; secretary, Gordon Ricketts, 3 Couch Street, Young; WIA delegate, VK2APP.

Meetings will be held monthly and an AOCP class has already been commenced with VK2VT and Royce Potter assisting. Enthusiasts in the district are invited to join and can write the secretary or phone VK2VT at Young 989 or VK2APP at Monteagle 286.

Jubilee year

THE first event to commemorate the 50th Jubilee Year of the N.S.W. Division of the WIA was the Joe Reed, VK2JR Birthday Party held at the Administrative Centre at Crow's Nest. The gathering included many really old-timers, some who were present at the inaugural meetings. Many past office-bearers were also present. It was an important gathering and stories were exchanged on many subjects. A suitable cake cut on the occasion was prepared and decorated by Brenda, daughter of the new State president Ted Whiting, VK2ACD.

The wives of amateurs present prepared a welcome afternoon tea.

It was 50 years ago, practically to the day, when on March 11, 1910, a meeting was held at the Hotel Australia, Sydney, to discuss the formation of the Wireless Institute of N.S.W. On April 22 of the same year the first general meeting of the Institute was held. In 1926 the Institute was incorporated as a company as the Wireless Institute of Australia, N.S.W. Division. Further events will be held of a similar nature during the jubilee year.

Old-timer passes

MATT O'BRIEN, VK4MM, reports the passing of one of Queensland's really old-timers, Arthur Dillon, who signed 4CH (no prefixes) in the 20s. He was a true pioneer in the wireless field organising Morse instruction while still at school for many of the original VK4s. Arthur graduated from rotary spark and Poulsen Arc to MQs, V24s, in various oscillator circuits. He was the last of the true Banana-lander pioneers, and sympathy is extended to his family.

7 Mcs band

A FEATURE of the 7 Mc Band is the evenings during March was the consistent signals JAs were putting into Australia on telephony. Signals were often peaking at S7 to 8 and a number of VKs worked them. The main problem was readability, not due to signal strength, but to the limited English of most of the Japanese operators. A number of KH6s were also audible. JA signals on CW were consistent, too, on 3.5 Mc during the last weekend of the W/VE DX contest.

They appeared to blot out in the US quite a number of VKs, who normally get across to the States on 3.5 Mc during this contest.

Higher power

IT is generally regarded that the U.S. is the centre of high power activity for radio amateurs—Californian kilowatts included. These days other countries are granting higher power privileges. Poland is a country in point, where first grade operators are permitted to use inputs up to 750 watts on both CW and telephony. Grade two operators 250 watts input for both modes; grade three 60 watts phone and CW; grade four 15 watts on CW only, the latter the equivalent of a novice class licensee.

All amateurs must be members of recognised clubs. Foreign amateurs living in, or visiting Poland, can obtain temporary licences by giving details of the qualifications held and the equipment to be used to the licensing authorities.

The U.S. 14 Mc Telephony Allocation has been extended from mid-March to high end of the band at 14,350 Kc. At the moment the operators of the various transmitting modes in other countries are sorting themselves out into various spots (if any) on the band.

G-visitor

AN interesting visitor to VK2WI in March was Nell Corry, G2YL, one of the best known YL operators in the world. Especially prewar she was active in the DX field and her call-sign was heard daily in many amateur shacks. When speaking over VK2WI, G2YL issued an invitation to all amateurs visiting the U.K. to make themselves known to the G gang.

TV interference

ONE of the most lucid methods of estimating the reason for TVI caused by an amateur station is presented in the February issue of the R.S.G.B. Bulletin. It takes the form of a diagnosis chart and shows the method of approach and means of identifying the various causes of interference. Any amateur with a TVI problem would be well advised to sight the article and chart prepared by R. H. Hammans, G2IG. It does not tell how to cure TVI, but it will help to find the cause in any particular case.

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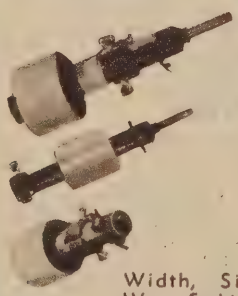

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4-6

ON SHORTWAVE BY ART CUSHEN

PRIVATE U.S. STATIONS TO INCREASE ACTIVITY

According to a recent announcement, the Federal Communications Commission has granted a licence to a new private short wave broadcaster and has received application for change of ownership of two other stations.

CHANGES in the private short-wave stations in the United States, recently announced, include the sale of the only two broadcasters to new owners.

Station WRUL in New York, which has long been established as "The Voice of Freedom," has been sold to a large United States radio organisation, Metropolitan Broadcasters, and is expected to soon be on a new schedule.

Radio KGEI in San Francisco, which recently resumed its operations with broadcasts for Latin American listeners, has been sold to the Far East Broadcasting Company of Manila. It is understood, if the sale is approved by the Federal Communications Commission in Washington, that the station will be used in religious broadcasting and beam its program to the Far East with the 50,000 watts of power it uses. The FEBC in Manila is now the biggest private broadcasting organisation and when the San Francisco and Okinawa stations are added to the network, it is expected to use 15 transmitters in its operations.

Newcomer to the short-wave broadcasting field in the United States is Global Broadcasters, which has applied to the FCC for permission to operate on 15180 Kc with 50,000 watts and carry programs for listeners in the Central American and northern section of South America on a commercial basis.

Global Broadcasters, which has the mailing address of 2663 Spring Vale Lane, Dallas, Texas, has been assigned the call of KFRM, and is under construction near Dallas. The new 50 Kw will utilise a frequency of 15180 Kc for its initial transmissions.

New services from Tokyo

THE introduction of additional transmissions from Radio Japan has been announced, and these include the use of an extension of five to 10 transmissions to East Asia and the introduction of a service to Korea. The Korean service, which is on the air from 11.00 p.m. to midnight uses JOB9 on 9525 Kc.

The General Asian service, which is of 30-minute duration unless otherwise stated, is of news in English and Japanese. The broadcasts are on the air at 10.00 a.m., noon, 2.00 p.m., 4.00 to 5.00 p.m., 6.00 p.m., 7.00 p.m., 8.00 p.m., 9.00 p.m., 10.00, and 11.00 p.m. to midnight. The transmissions are on JOB 15 on 15135 Kc.

The popular DX Hour from Tokyo will also be extended, and it will now be released on the third and fifth Saturday to North America, 4.00 p.m.; to Europe, 6.10 p.m.; to Australia and New Zealand, 8.15 p.m.; Philippines and Indonesia from 10.15 p.m. and Middle East from 4.25 a.m. on Sunday.

YDL2 on 5990Kc

A NEW station of the Radio Republic Indonesia network has been established at Pakanbaru in Sumatra. The callsign was previously allocated to the Pedang transmitter but the new station appears to be on a regional basis and relays the key Pedang programs.

YDL2 at Pakanbaru, operates from 9.27 a.m. to 11.30 a.m. and from 8.27 p.m. to 1.30 a.m. Another new Indonesian frequency, that of 7115 Kc, has been noted at 9 p.m. with fair signals, though side interference is rather heavy. This is station Den Paser on Bali, which is on the air from 7.30 p.m. to 1.30 a.m

Cuban station active

THE recent unsettled nature of life in Cuba has had its effect on broadcasting also and the stations of that country have been reduced in number of recent weeks. A new list of the stations from World Radio Handbook will supply readers with the present broadcasting arrangements as these stations will be heard over the next few months in the late afternoons and early evenings.

COCW 6270 Kc 8.00 p.m. to 3.00 p.m.
COBZ 9030Kc 2.00 a.m. to 2.00 p.m.
COBQ 9235 Kc midnight to 3.00 p.m.
COBC 9362 Kc 8.30 p.m. to 4.00 p.m.
COKL 9620 Kc 10.00 p.m. to 3.00 p.m.
COCO 9535 Kc 10.00 p.m. to 12.30 a.m. 6.00 a.m. to 3.00 p.m.
COCQ 9670 Kc 8.30 to 3.00 p.m.
COBL 9833 Kc 24 hours daily.
COBH 11800 Kc 11.00 p.m. to 3.00 p.m.

The power of all transmitters is 1,000 watts, with the exception of COCO, which uses 250 watts.

DX program

THE popular Radio Australia DX session conducted by Graham Hutchins is now on its winter schedule. The program is now broadcast on Sundays as follows:

8.00 a.m. on 15240 Kc to East Asia and North Pacific.

3.30 p.m. on 21680 Kc to Africa.

5.15 p.m. on 11710 Kc to United Kingdom and Pacific.

11.00 p.m. on 11810 Kc to North America.

Monday, 2.00 a.m. 11740, 9580 and 7220 Kc to East Asia.

FLASHES FROM EVERYWHERE

SPAIN'S National radio in Madrid has made an alteration to its frequency for the relay of the home program. This is now broadcast on 6010 Kc, and the station broadcasts from 6.00 p.m. to 11.00 a.m. In this area, considerable interference from Rome, which uses the same frequency is experienced at 6.00 p.m. Omdurman in the Sudan has made a frequency change for its 25-metre band station, which has been moved from 11915 to 11855 Kc. A Swiss report states signals are good in Europe after 3.00 a.m.; when Radio Free Europe leaves the frequency and this is the case till Omdurman in Khartoum signs off at 8.00 a.m.

MONTE CARLO, the home of Trans-World Radio, is soon to test its 100 Kw transmitters in preparation for them to go into regular operation in October. The station, which was formerly the Voice of Tangier in Morocco, but moved its facilities to Monaco early this year, is expected to use the old frequencies, which were assigned to WTAN. The regular broadcasts of the station are scheduled to commence on October 1.

MONROVIA with signals of ELWA uses 21515 Kc to North America on Tuesday, 9.00 a.m. to 10.45 a.m., with the same program being carried on 15200 Kc. An increase in signal strength is reported by a Los Angeles listener. On Wednesday from 11.00 a.m. to 12.35 p.m. the session is carried on 21515 and 11986 Kc, with United States being the area to which broadcasts are directed.

PHILIPPINES DZF2 in Manila was recently the subject of a special dedication program, when power of 50 Kw was used from the new broadcasting site of the Far East Broadcasting Company, at Radio City in Bacoue. This is the

NEW BIAK FREQUENCIES

LAST month we reported reception of the Dutch New Guinea station on 6070 Kc. and, since then, other new frequencies have been heard. The programs of Radio Omeroup Neiuw Guinea, which were heard on 6070 Kc. have now been noted on 6075 Kc., while a new frequency in the 80 metre amateur band of 3735 KC. has also been heard well in the evenings. The station now appears to be using this schedule, Tuesdays to Sundays from 7.00 to 8.00 a.m. on 6075, Sundays from 9.30 a.m. to 2.30 p.m. on 9745, and 5040 Kc. The evening transmission daily from 7.00 p.m. to 11.0 p.m. is now broadcast on 6075 and 3735 Kc.

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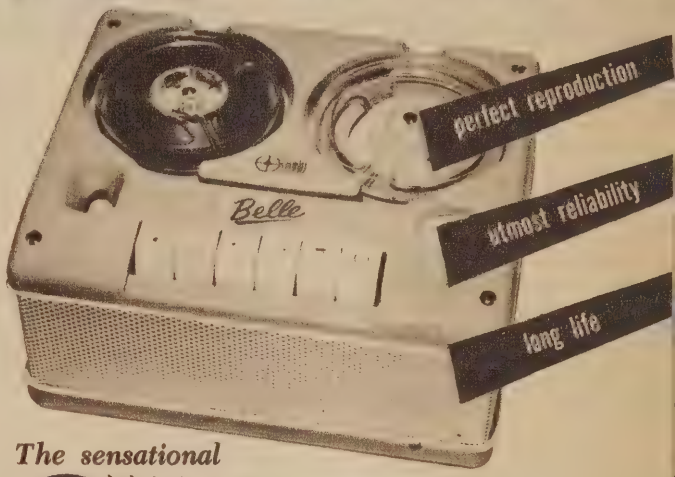

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new site for the FEBS broadcasting studios and transmitters. DZF2 was formerly using 11920, but recent reports give its transmissions as being on 11935 Kc.

SINGAPORE with test transmission of Radio Singapore are reported on 4780 Kc. The station has been heard from 9.00 p.m. to 12.30 a.m. with transmissions, which are of a test nature. Radio Singapore, it is presumed, will be the voice of the new colony. In the past, the programs of Radio Malaya, which has its headquarters in Kuala Lumpur, have originated from Singapore.

BUDAPEST in Hungary has been using new frequencies for its transmission to Australia and New Zealand. Reception of the 19-metre signal on 15415 Kc is fair to good, through jamming, but the 21685 Kc is too high a frequency for reception in this area at this time. The broadcasts are heard daily from 4.30 to 5.30 p.m. on these two channels.

CAMBODIA is reported by a Japanese listener to be using the frequency of 9700 Kc for its foreign service. The program includes news in English at 11.30 p.m. and French at 11.45 p.m.

VIENNA still continues to carry out transmissions on short wave from the Austrian capital, and some of the tests on the 4,000-watt transmitter are often heard in this area, in particular the one on 5985 Kc, which is heard to 6.00 p.m. The other frequencies which are reported in operation, are 6155, 7245, 9505, 9665, 11785 and 11935 Kc.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, N.Z. All times are Eastern Australian Time.

BRAZZAVILLE continues to be heard on its overseas transmissions, and the one to the Far East is now broadcast on 21500 and 17725 Kc, and has news in French at 11.30 p.m. and 2.00 a.m. and in English with news at 12.30 a.m.

JORDAN is the location of the signal which is heard on 11812 Kc. The station signs on at 3.00 p.m. and is still heard by listeners in Europe to after 6.00 p.m.

PESHAWAR in Pakistan has commenced to operate on short wave and its schedule is now, noon-1.00 p.m. on 3241 Kc; 5.00-7.00 p.m. on 9689 Kc; 9.30-10.45 p.m. on 7130 Kc; 11.30 p.m.-3.00 a.m. on 3241 Kc. Dacca in East Pakistan is now operating from 10.00 a.m. to noon on 5980 and 15305 Kc; 3.30-4.30 p.m. on 9614 Kc and 21690 Kc; 8.00-10.15 p.m. on 7140 and 21690 Kc; 10.30 p.m. to 1.30 a.m. on 5970 and 11865 Kc.

UPPER VOLTA with Radio Haute-Volta, Ougadougou, is now operating on 4815 Kc with 4 Kw, from 10.15 to 11.15 a.m., 4.30 to 7.30 a.m. with schedule on Sundays extended to 8.30 a.m.

VENEZUELA station YVKP "Radio Tropical" has made a frequency change from 3345 to 4900 Kc; its broadcasts come from Caracas. YVQE "Radio Bolivia" formerly on 4900 is now not operating.

SARAWAK have made a frequency adjustment for its Chinese and Iban service it now being on 4835 Kc instead of 5038 Kc. The English broadcasts on 4950 Kc, 8.30-10.00 p.m., 11.00-p.m.-12.30 a.m.

ROUMANIA is now heard very well in the afternoons with the transmission to North America. The station uses several frequencies, and the best received are on 9570, 6210 and 5980 Kc. The latter is the best frequency in this area and has English from 2.30 to 3.00 p.m. On the fourth Friday of each month a program for the Radio Amateur and the DXer is broadcast.

Last minute items

A SUMMARY of late items from listeners includes reception of the Singapore tests now on 4820 Kc and, in the period from 8.30 p.m. to 9.30 p.m. in Tamil; 9.30 to 10.30 p.m. in Malay; 10.30 to 11.30 p.m. in Chinese and 11.30 p.m. to 12.30 a.m. in English. The station relays the medium-wave programs which are carried on 630 Kc. Radio Mauretania has been heard by Dick Pollard in Golden Downs, N.Z., with broadcasts to 6.00 p.m. using 4855 Kc, the broadcasts originating from Dakar. ZYN31 using 15125 Kc has given fair reception to sign off at 2.00 p.m.

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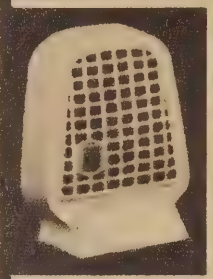

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U or F40/285	40	285/285	6.3v/2a 5v/2a	3 3/8	2-13/16	2 3/8
U or F40/325	40	325/325	6.3v/2a 5v/2a	3 3/8	2-13/16	2 5/8
U or F50/225	50	225/225	6.3/2a	3	2 1/2	2 1/4
U or F60/285	60	285/285	6.3v/2a 5v/2a	3 3/4	3 1/8	3 3/8
† U60/300	60	300/300	6.3vct/1a 6.3v/1a	3 3/4	3 1/8	2 1/2
U or F60/325	60	325/325	6.3v/2a 5v/2a	3 3/4	3 1/8	3 1/4
U or F60/385	60	385/385	6.3v/2a 5v/2a	3 3/4	3 3/8	3 1/2
▪ U80/250T	80	250/250	6.3v/2a 5v/2a	3 3/4	3 1/8	4 1/8
† U80/250	90	250/250	6.3vct/2a 6.3v/.6a	3 3/4	3 1/8	2 1/2
U or F80/285	80	285/285	6.3v/2a 6.3v/2a 5v/2a	3 3/4	3 1/8	4 1/8
† U80/300	80	300/300	6.3vct/2a 6.3v/.6a	3 3/4	3 1/8	4
U or F80/325	80	325/325	6.3v/2a 6.3v/2a 5v/2a	3 3/4	3 1/8	4 1/8
U or F80/385	80	385/385	6.3v/2a 6.3/2a 5v/2a	3 3/4	3 1/8	4 1/8
U or F100/285	100	285/285	6.3vct/2a 6.3v/2a 5v/2a	4 3/4	4 1/8	3 3/4
U or F100/325	100	325/325	6.3vct/2a 6.3v/2a 5v/2a	4 3/4	4 1/8	3 1/2
U or F100/385	100	385/385	6.3vct/2.5a 6.3v/2a 5v/2a	4 3/4	4 1/8	3 3/8
U or F125/285	125	285/285	6.3vct/2a 6.3v/2.5a 5v/2a	4 3/4	4 1/8	3 5/8
U or F125/325	125	325/325	6.3vct/2a 6.3v/2.5a 5v/2a	4 3/4	4 1/8	4 1/8
U or F125/385	125	385/385	6.3vct/2a 6.3v/2.5a 5v/3a	4 3/4	4 1/8	3 7/8
† U150/250	150	250/250	6.3vct/4a 6.3v/1a	4 1/8	3-7/16	3 1/4
U or F150/285	150	285/285	6.3vct/2a 6.3v/2.5a 5v/3a	4 3/4	4 1/8	4 5/8
U or F150/325	150	325/325	6.3vct/2a 6.3v/2.5a 5v/3a	4 3/4	4 1/8	4
U or F150/385	150	385/385	6.3vct/2a 6.3v/2.5a 5v/3a	4 3/4	4 1/8	4 3/8
U175/425	175	425/425	6.3vct/3a 6.3v/2a 5v/3a	4 3/4	4 1/8	4 5/8
● U180/305	180	305/305	6.3vct/4a 6.3v/4a 5v/2a	4 1/2	3 3/4	5 1/8
† U180/410	180	410/410	6.3vct/4a 6.3vct/ 2.5a 5v/3a	4 1/2	4 3/4	4 3/4
● U190/127	190	317VDC	6.3v/7.5a	3 3/4	3 1/8	4 1/8
U200/385	200	385/385	6.3vct/3a 6.3v/3a 5v/3a	4 3/4	4 1/8	5 1/4
U250/385	250	385/385	6.3vct/4a 6.3v/3a 5v/3a	4 3/4	4 1/8	5 1/4

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R.B.R. (Graymore, S.A.) writes in to ay that he would like to see us publish n addition to the Playmaster range of mplifiers in the form of 6BM8's in push ull. R.B.R. would also like a control nit for stereo after the style of our No. 6 Control Unit. He goes on to ask he relative merits of 12 cu. ft. brick enlosures, with or without ports, to house 5 cycle cone speakers.

A.: We have considered the design of n amplifier along the lines you mention nd one is on the way. Likewise, we ave considered a high gain preampliier with step type controls but at the noment we are unable to make any denite promises. With the speakers you re using and with the size of enclosures roposed we would recommend a sealed nclosure. We feel that a vented enclosure is not required to offset the speaker's ehaviour at resonance with such low esonance speakers. For a more comrehensive discussion on speakers and neir behaviour in various enclosures, we ecommend a series of articles published n our September, October and Novemer, 1956, issues. A limited number of hese issues is available through our uery service.

J.W. (Tamworth) offers some informaon which he hopes will help D.R. Ballarat) who inquired about guitar mplifiers. He reports that in the Decemer 1958 issue of the magazine "Elecronics Illustrated" there appeared a 5-alve guitar amplifier, with tremolo, uitable for 117 volt mains, which he uggests may be adaptable. J.W. also eports some difficulty in getting the ransistorised Morse Oscillator to work, nd asks about "three element beams."

A.: Thanks for your information for .R., J.W. We agree that the trick of orting the base directly to the lower nd of the 0.1 mfd capacitor would proably make the oscillator work, by proiding more feedback. However, doing his upsets the DC bias provided for the ase of the transistor and also tends to ower the efficiency of the tuned circuit ue to the low impedance of the base ircuit.

A better plan would be to make the ame connection using a capacitor, thus ncreasing the AC feedback without upetting the DC conditions. Some trial will ave to be done to find a satisfactory alue, but we suggest you try a 0.05 mfd nit for a start. The circuit as originally own should work well, however, proiding the transistor and transformer are order.

A "Three Element Beam" is a type f aerial which improves on the direcvity of a normal dipole aerial by adding vo more parts or elements. One, called the "reflector," is a metal rod about per cent longer than the actual dipole, nd placed parallel to it, at a distance f half the dipole's length (i.e., one quarr of a wavelength) to the desired rear f the aerial system.

The other, called the "director," is out 5 per cent shorter than the dipole, nd is placed at a distance of half the pole's length to the desired front of e aerial. This type of aerial is used r both transmitters and receivers, and is preferred to the simple dipole for narow-band usage, because the improved directivity means a more efficient system. This is because less radio energy is radiated in the wrong direction at the transmitter and less "other direction" signals are picked up at the receiver.

P.R.W. (Beecroft) tells of an experience with a detector formed by an oxidised metal contact, and also asks if an output transformer of dubious character and value could spoil the performance of the Three Transistor Mantel set. He also inquires as to the connection for the "decibel" ranges on his multitester.

A.: The rectifying properties of oxide coatings on metals have been known for some time, P.R.W., and this effect is used in the copper-oxide rectifier. Such a dirty contact is reputed to have been used during the war by prisoners-of-war to receive messages, but they have the peculiarity of being unreliable in this simple form. For modern electronic circuitry, a diode formed of say a semiconductor junction proves to be both easier to manufacture accurately and more reliable in operation.

The output circuit of the Three Transistor Mantel Set is designed to operate into a load of approximately 400 ohms, for which is needed a transformer designed for low impedance circuitry. Most old transformers in the junk-box would probably be from valve type circuits, and would be of much higher impedance than the above figure. Thus, when a transformer of this type is used in the above circuit, a weak and distorted output would probably result.

The decibel scales of a normal multimeter are used in conjunction with the voltage terminals, P.R.W., thus allowing a measured ratio of voltages to be read off as decibels if desired. As you noticed, the scale on your particular meter is calibrated in dB from minus 15 to plus 18. This would mean that if a voltage say 10 volts registered plus 8 dB on the 30-volt range, it would read minus 2 dB on the 100-volt range if this were the next range. This is because a scale multiplier of 3 as far as voltage is concerned corresponds to adding 10 dB to the indicated decibel reading.

R.H. (Gosford) asks about the type of dropping resistor needed to run a 6-volt car horn from a 12-volt car system.

A.: The size of resistor required depends on the horn, R.H., and how much current it draws. If it draws 5 amps at 6 volts (i.e., it is a 30-watt model), then the resistor needed must drop the remaining 6 volts when the same current is flowing. Using Ohm's Law, we get a value of 1.2 ohms for the resistor in this case. And since it, in common with the horn, drops 6 volts when 5 amps are flowing through it, it needs to be a 30-watt rating unit also. You may possibly have some trouble in making a unit of this type, R.H., so we suggest consulting a resistor manufacturer or distributor.

RADIO, TELEVISION AND HOBBIES QUERY SERVICE

TO assist our readers, "Radio, Television and Hobbies" conducts a technical query service. Conditions governing this service are set out below:—

(1) Requests for copies of circuits or technical queries requiring an answer through the post must be accompanied by postal note or stamps to the value of TWO SHILLINGS. Queries not accompanied by a fee will be answered in rotation on these pages.

(2) For the 2/ fee, we will supply circuit data, as available, for up to three projects. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. As a rule, requests for circuits will be answered more speedily if they are clearly identified and not complicated by questions requiring the attention of technical personnel.

(3) The technical query service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits.

(4) The Editor reserves the right to return query fees or to limit the scope of an individual reply, where it is felt that a partial answer will be better than none at all. Please note that the inclusion of an extra fee does NOT entitle correspondents to special consideration.

(5) In addition to the normal query service, chassis blueprints are available for most of our projects, showing the position of all holes and cutouts for metal-working but containing no details of wiring, etc. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost 5/ each. Original photographs of most projects are also available, from 5/ for a 6in x 8in glossy print; postage 9d extra.

(6) Letters should be addressed to the Technical Editor, "Radio, Television and Hobbies," Box 2728, G.P.O., Sydney.

(7) "Radio, Television and Hobbies" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications of merchandise must be obtained from our advertisers.

(8) Technical queries are not answered by telephone.

ACOS MICROPHONES

LAPEL MICROPHONE MIC28
Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft moulded rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel.
PRICE: £5/19/6.

VIBRATION MICROPHONE TYPE VP1
The VP1 Vibro-Voice has been specially designed for use with guitars, double bass and, in fact, all stringed instruments. With the use of this simple yet effective pick-up, together with a good quality amplifier, any instrument can be amplified. The VP1 has ample output and a frequency range which extends to approx. 6 K/cs. The tough rubber case protects the instruments from damage.
PRICE: £7/15/-.

CRYSTAL STICK MICROPHONE MIC39-1
The MIC39-1 has been beautifully styled as a hand, desk or floor stand unit, and precision engineered to the highest professional standards. A heavy die-cast liner in the microphone case eliminates the possibility of hum pick-up due to hand capacity effects. The use of a special noise-free cable improves screening and gives a greatly increased signal-to-noise ratio.
PRICE: £7/19/6 complete.
Desk stand extra.

CRYSTAL MICROPHONE MIC40
The MIC40 has been pleasantly styled in two-tone colour to give a handsome, quality Microphone of modest dimensions and unassuming price. Ideal for tape recorders with a minimum of stowage space available. £3/19/6.

Sole Australian Agents:

AMPLION (A'sia) PTY. LTD. 101 Pyrmont Bridge Rd., Camperdown. Sydney, N.S.W. Phone LA 6124

Victorian Distributors: DISTRIBUTORS CORPORATION, 403 Bourke Street, Melbourne.

CLEARANCE OF PORTABLE RADIOS

Limited supply only of the powerful Ferris Model 107 broadcast and short wave portable receiver in sturdy metal case with retractable ferrite rod aerial and full-sized speaker.

ONLY £16/10/-

(Battery not included takes Standard Eveready 753)

These unused receivers incorporate many unique features, including complete screening and provision for attaching an external aerial for motor car use, tuned R.F. stage, high gain coils and I.F.'s. Ideal for long-range country use or as all purpose portable receiver.

A Ferris Set Built to Last

FERRIS BROS. PTY. LTD.

Available from all Ferris branches.

252 DOWLING STREET, EAST SYDNEY. TELEPHONE 35-4356.

51 DENISON STREET, HAMILTON, NEWCASTLE. TELEPHONE 61-5071.

6 VICTORIA STREET, WOLLONGONG. TELEPHONE B1922

576 ELIZABETH STREET, MELBOURNE. TELEPHONE FJ6634.

752 PITTWATER ROAD, BROOKVALE, N.S.W. TELEPHONE XF0221.

B.E.J. (Maylands, W.A.) is interested n the Six-Volt Tachometer recently described and wants to know if it can be dapted for use with a 2-cylinder motorycle engine.

A.: This is an interesting thought, .E.J., but we would need to know a ood deal more about the engine beore we could give an answer. Among he points to be considered are the folowing: The expected top speed of the ngine and whether the number of pulses er second would be sufficient to give ull scale deflection. If not, what order f meter sensitivity would be needed to chieve this. Also whether the engine is two-stroke or four-stroke, and whether nagneto or coil ignition is used. If the atter, whether there is a low tension ircuit available from which the pulses nay be taken and whether (if a fourtroke) the magneto fires once per cycle r twice per cycle. (Two pulses per ycle are sometimes used to allow the nagneto to operate at a more efficient peed.) Assuming all this information vas available, it should be a relatively imple matter to calculate the p.p.s. for given engine speed and relate this to he published performance of the instrunent. Frankly, we are not sufficiently amiliar with all makes of engines to now all the possible combinations, but ther readers may be able to offer advice ased on experience.

Record Review

(Continued from Page 107)

uthority, Mr Werner Baer, N.S.W. musical superintendent of the Australian Broadcasting Commission, who confirmed ny doubts about its authenticity. Acording to him there has been a tendency for many years to make Jewish iturgical music "more acceptable" to nodern congregations with the result that strong influence of Mendelssohn and arly Verdi has crept into the services.

Even in this form some of the music as undeniable beauty and retains nough of its original characteristics to ive it an exotic interest to the ordinary istener. What has disappeared is the tmosphere of antiquity that has survived n the Gregorian chants used in the Roman Catholic church. Richard Tucker ings with an emotion-laden voice that uggests a heavy burden of affliction, which, Mr Baer informed me, is the rthodox manner of delivery.

NEW CONTROL UNIT

(Continued from Page 58)

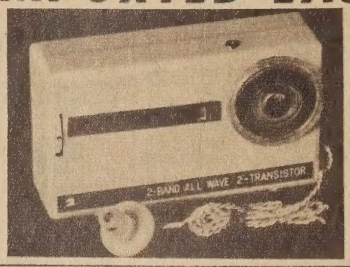
f earth returns to the mains at more han one point.

In a high-gain amplifier such as this, arth loops and the subsequent hum hey produce are more pronounced and few precautions with regards to earthng are worth observing.

The equipment as a whole should be arthed only via the main chassis and ts normal 3-wire connection to the ower point. The motor assembly may e earthed to the power point only if t makes no connection to the pickup iring.

If the earthy side of the pickup lead s connected to the player frame, the atter must be earthed only via the conrol unit.

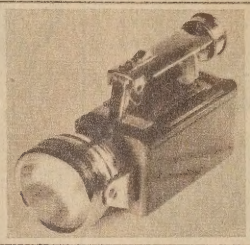
IMPORTED EASTER SPECIALS



A SHORT WAVE & BROADCAST TRANSISTOR RADIO
(pocket size)

complete with battery (2 Torch cells 2/6), earphone, etc.

£10/10/-

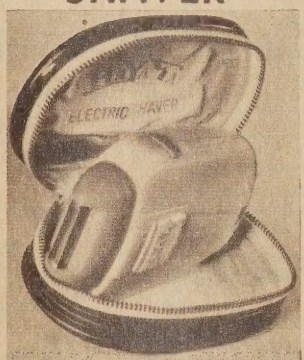


POWERFUL SEARCHLIGHT HAND LANTERN

With red warning blinker for camping and household use. Recharge with standard Eveready 509 battery.

Complete 37/6

SHAVER

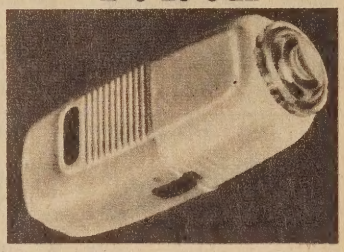


This electric shaver operates from two torch batteries fitted inside the shaver. No wires or outside power, just switch ON and shave.

£2/19/6

With spare battery 2/6.

Rechargeable TORCH



Pocket Torch which operates without dry batteries. Rechargeable Torch, just remove back and plug into the power point, recharges overnight.

59/6

Spare globe 2/6.

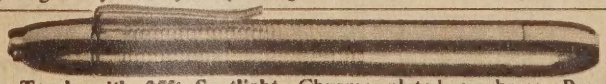
WAHL HAIR CLIPPERS

Special £14/14/-

The famous American "WAHL" Super Hair Clippers. Professional type for 240 AC power. Cutting length adjusted by simple finger control.

Transistor Radio 9 Volt 216 Batteries

Blue Dove, 5/9
Maxell and Eveready, 8/6
Post, 1/ extra.



Penlite Torch with 25ft Spotlight. Chrome plated on brass. Press button switch and locks on when required.

Complete 25/- with batteries

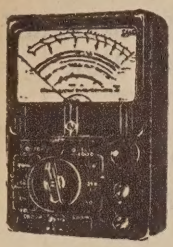
Radio House Pty. Ltd.

296 PITT STREET, SYDNEY

Also available at: 6 Royal Arcade and 760 George Street, Sydney.
Please add 3/6 for postage.

SPECIAL

SANWA MULTIMETERS MODEL SP.5



FEATURES: 2,000 ohms per volt A.C. and D.C.

VOLTS: A.C. and D.C.: 0-10V, 50V, 250V, 500V, 1,000V. D.C. mA: 0-.5, 25, 500.

OHMS: 0-10K ohms, 0-1M ohm.

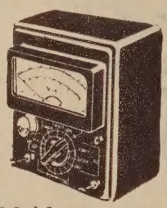
CAPACITANCE: 100pf-.03mfd, .01mfd-.6mfd.

INDUCTANCE: By applying external source, 10-1,000 H.

DECIBELS: By applying external source, minus 20 to plus 22 (at A.C. 10 volts range). Plus 20 to plus 36 (at A.C. 50-volt range). Supplied complete with batteries and test leads.

ONLY £6/17/6 Postage 8/6.

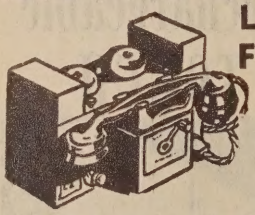
MODEL 305G



FEATURES: High internal resistance.
A.C. VOLTAGE: 10V, 50V, 250V, 500V, 1,000V (8,000 ohms per volt).
D.C. VOLTAGE: 10V, 50V, 250V, 500V, 1,000V (20,000 ohms per volt).
D.C. CURRENT: 50 micro amps, 2.5mA, 25mA, 250mA.
RESISTANCE: 5K, 50K, 500K, 5meg. (using internal batteries).
DECIBELS: 0db—plus 22 (at A.C. 10-volt range). 0db—0.775 volts—600 ohms.

ONLY £12/19/6 Postage 8/6.

LOW COST FIELD TELEPHONES

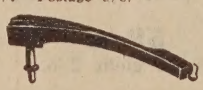


Efficient, reliable and trouble-free method of inter-phone communication. Foolproof in operation, easy to install, simply connect two units with telephone wire and your phones are ready to use. Supplied complete with batteries in a sturdy wooden carrying case.

£6/10/- ea. Del. to Rail 5/-.

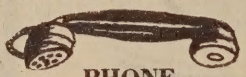
"ACOS" PICKUPS

A CRYSTAL PICKUP. Incorporates the HGP37 turnover cartridge with cantilever stylus for standard or microgroove recordings. ONLY £3/15/. Postage 3/6.



Light-weight crystal pickup with die cast arm construction increasing torsional rigidity, minimising arm resonance. Turn-over cartridge for standard or microgroove recordings. Only £3/19/6, postage 3/6.

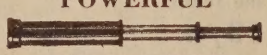
SOUND POWERED PHONE



NO BATTERIES REQUIRED. Ideal for television aerial installation, contractors and similar projects.

49/6 ea. Postage 3/-.

POWERFUL TELESCOPES



Smartly finished three-draw instrument giving 25 magnifications through blued lenses. Brand-new and complete with neat pigskin case. This is the buy for you.

£3/12/6 Postage 2/6.

LOOK!!

RIFLEMEN

These 4½in sealed beam units are made especially to suit the requirements of the night shooter and are supplied with fittings to suit both rifle and shotgun barrels. A silent push-pull switch ensures quick, noiseless operation at a moment's notice.

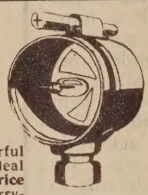
PRICES: 6 volt £3/12/11; 12-volt, £3/16/6. Postage 8/6.

MOTORISTS! POWERFUL SEALED BEAM SPOTLAMPS

Finished in black baked enamel with a red plastic pistol-grip handle and thumb operated switch. Its 4½in sealed beam gives a powerful light enabling the motorist to pick out street names and house numbers without leaving the car.

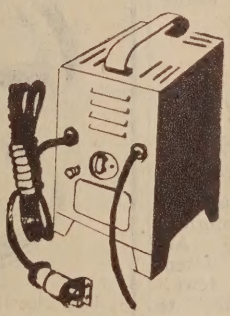
PRICES: 6-volt type, £4/2/1; 12-volt type, £4/5/8. Postage 8/6.

LUCAS SIG. LAMPS



Compact, only 4in in diameter and with a parabolic mirror, these powerful lamps make ideal spotlamps. **Price 50/.** Metal carrying case and Morse key to suit, 12/6. 3ft tripod, 25/. Del. to rail, 5/.

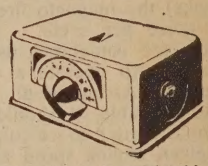
MOTORISTS BATTERY CHARGERS



New, imported 2 amp. Work off household power supply. Complete with flex and plugs. In addition we supply a female socket which can be permanently wired to your battery, enabling you to plug-in your charger, trouble lamp, etc., at a moment's notice.

£5/-/-
Del. to Rail 5/-.

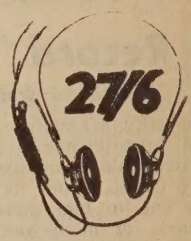
CRYSTAL SETS



4 x 2½ x 2½ inch metal cabinet, germanium diode detector and slug tuner. The earphones or crystal earpiece shown below are suitable for use with this set.

ONLY 39/6
Postage 2/6.

HEADPHONES



New, imported, high impedance (4,000 ohms), complete with leads and tips. Ideal for crystal sets.

Postage 3/6.

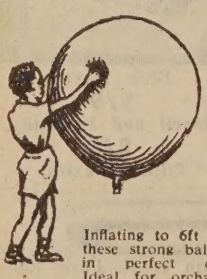
CRYSTAL EARPIECE

Ideal for transistor radios, crystal sets, etc. Complete with cord and plug.

15/- Postage 2/6.

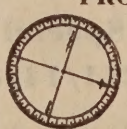
GIANT BALLOONS

20/-



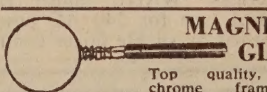
Inflating to 6ft in diam., these strong balloons are in perfect condition. Ideal for orchardists to protect crops.

PROTRACTORS



Finely graduated 360 degree protractors of superior quality. Made of clear perspex with a slight blue tinge for easier reading, they are ideal for draughtsmen and students. **3/6 each,** postage 2/6.

MAGNIFYING GLASSES

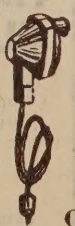


Top quality, imported, chrome frame, plastic handle.

3in diameter lens 17/6
2½in diameter lens 12/6
1½in diameter lens with metal handle, 4/6

Postage 1/6.

BARGAIN Carbon Mikes

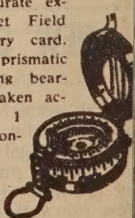


Solidly constructed 2½in diam. hand mikes complete with 3ft flex, jack plug and two-pin parallel female socket.

LOOK!

ONLY 7/6
Postage 2/6.

PRISMATIC COMPASS



A most accurate ex-Army pocket Field Compass: Dry card, with a prismatic sight enabling bearings to be taken accurately to 1 degree. Reconditioned, as new.

£8/10/-
Postage 4/6.

METROPOLITAN RADIO SUPPLIES

640 KING STREET, ST. PETERS, N.S.W. **PHONE 51-8087**

MUCH TO LEARN ABOUT VOLCANOES

(Continued from Page 19)

r time period for the eruptions, so at those in charge of the parks where ese curiosities are located can tell sitors the exact minute when the yser will perform.

The mechanism of a geyser is well own and is nothing like the mystery a volcano. Beneath the surface at e site of a geyser is a deep layer of va hundreds of feet in depth. This is ade up of layers of solidified lava ntaining cracks, crevices and small ve-like formations and a central pipe ding to the surface.

Deep down in the layers there is a nstant heat because, over the centuries e lava has never cooled down because intense thermal activity in the surnding area.

Through a lot of these cracks and evices water seeps from the surface d from underground springs. This ater gradually fills the cavities and ve-like structures where it is heated the surrounding hot rock.

Steam begins to form and fills the vities above the water, where it benes trapped and, being under pres-e, becomes superheated because the at of the surrounding rocks is far ove boiling point.

When the pressure becomes too great forces the water out from all the vices and up the pipe to the open air ere it emerges with a great show h into the air. At the end of the ption the water begins to fill the vities once again, until the next cycle complete and she's off again!

GULAR CYCLES

With water flowing at a uniform rate o the cavities and being heated with niform temperature it is easy to exin the regularity of the cycles of ption.

With the exception that there is no ption, hot springs and lakes are much e geysers. The cracks in the underng rocks are too wide and straight be plugged so that there cannot be pressure to cause an eruption. The ter just boils and bubbles and may rflow.

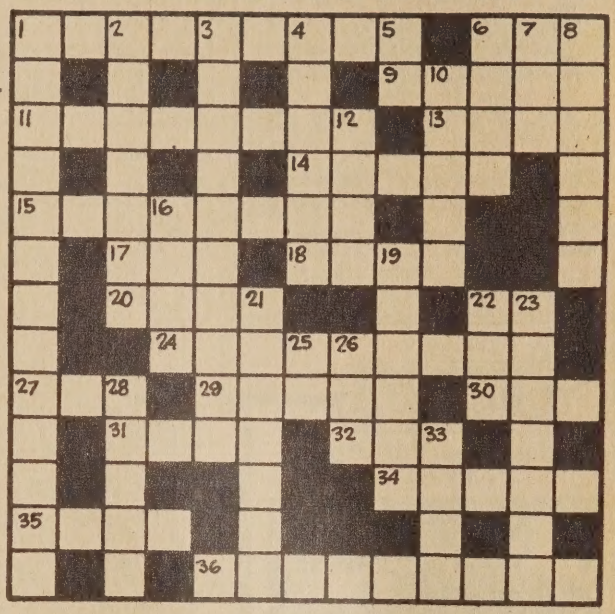
Boiling mud lakes are similar to hot es. The water erodes the sides of the e, mixing the water with the soil o mud.

Around a geyser there are often formons of different coloured stones. This called geyserite, and consists of pares of quartz dissolved in the water as merges from the geyser. This settles to other rocks and forms wonderful oured pictures and shapes.

There are some plants of a slimy ure which live in the hot water. Some these plants are white, some yellow, k, brown and green. When the geyte settles on to these plants it makes wonderful sight, with the colours wing through the clear transparent ering.

We thus see that volcanic action is omplex thing with most of the mechism yet not understood. Perhaps as e goes on man may find some means nvestigating the interior of the earth. s about the only place he shows no s as yet of being able to conquer.

THE R., TV & H. CROSSWORD No. 73



ACROSS

1. Type of mixer valve.
6. Girl's christian name.
9. Pertaining to Ohms.
11. Type of frequency changer.
13. Seaport of Western Samoa.
14. Unit of magnetic flux density.
15. Part of the head (pl.).
17. Objective.
18. To declare untrue.
20. To look at offensively.
22. Milliamps (abbrev.).
24. System of broad-band tuning.
27. Period of time.
29. Moved closer to.
30. Space between contacts.
31. Indian dress.
32. Member Legislative Assembly (abbrev.).
34. One of the muses.
35. Chances.
36. Planners.

DOWN

1. Resolves phase modulation.
2. By nature.
3. Measures hearing characteristics.
4. Surrounded
5. Execute.
6. Unit of electric current (pl. abbrev.).
7. Seven (Roman numerals).
8. Species of tree.
10. Speedy.
12. Without difficulty.
16. Untruths.
19. Used for sewing.
21. To emit energy.
22. Unit of resistance (abbrev.).
23. One who converts for another purpose.
25. Governor-General (abbrev.).
26. Precious stone.
28. To one side.
33. Group in Galway Bay—island.

TV FOR BROKERS

THE first British closed-circuit television system to be installed in Wall Street is now enabling busy executives of a large New York stockbrokers to study the latest ticker-tape stock market movements without leaving their offices.

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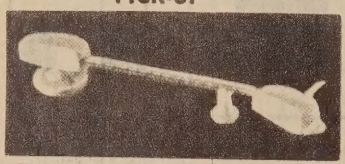

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